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A STUDY OF AIRCRAFT POWERPLANT EMISSIONS

Prepared for

ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF EMISSION CONTROL TECHNOLOGY

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Emissions from forty-two light aircraft piston engines and twenty-six military gas turbine engines have been measured and documented. Piston engine aircraft were leased from local general aviation suppliers and the engine exhaust emissions tested using a ten mode test cycle during a ground run-up. In addition crankcase ventilation emissions were measured on six engines and mass emission rates were calculated. Gas turbine engine emission measurements were performed at the Naval Air Rework Facility (NARF), on overhauled engines and engines recently removed in a four mode test cycle in a sea level test chamber. Exhaust component concentrations and fuel consumption rates were measured at specified engine operating conditions. The exhaust analyzer readings were converted to pollutant concentrations and mass emission rates. The data were analyzed to determine engine-to-engine variations for each model engine, the effect of hot versus cold start, and the role of engine operating parameters.

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A Study Of Aircraft Powerplant Emissions

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January 3, 1971

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Plumsteadville, Pennsylvania 18949

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SUMMARY

Under contract with the Environmental Protection Agency, Scott Research Laboratories, Inc. has measured and documented the emissions from forty-two light aircraft piston engines and twenty-six military gas turbine engines.

Piston engine aircraft were leased from local general aviation suppliers and the engine exhaust emissions tested using a ten mode test cycle during a ground run-up. In addition, crankcase ventilation emissions were measured on six engines and mass emission rates were calculated. Gas turbine engine emission measurements were performed at the Naval Air Rework Facility (NARF), Norfolk, Virginia on overhauled engines and engines recently removed from aircraft for diagnosis. The gas turbine engines were operated by Navy personnel in a four mode test cycle in a sea level test chamber as a part of their normal qualification procedure.

Exhaust component concentrations and fuel consumption rates were measured at specified engine operating conditions. The exhaust analyzer readings were converted to pollutant concentrations and mass emission rates. The data were analyzed to determine engine-to-engine variations for each model engine, the effect of hot start versus cold start, and the role of engine operating parameters.

1.0 INTRODUCTION

This report describes the work performed by Scott Research Laboratories, Inc. on Environmental Protection Agency Contract No. 68-04-0037. This work was part of a Federal program to acquire a statistically sound data base for aircraft power plant emissions in order to allow the rational setting of mass emission standards.

1.1 PROJECT OBJECTIVES

The aim of this program was the documentation of the emissions of both aircraft piston engines of the general aviation fleet and gas turbine engines similar to those in commercial aviation service, so as to establish the nominal level and the engine to engine variations of the particular engine model. The specific objectives were to document the emissions of carbon monoxide, hydrocarbons, nitrogen oxides and aldehydes from aircraft piston engines during ground run-ups and from gas turbine engines during test cell qualification runs.

1.2 METHODOLOGY - PISTON ENGINES

Exhaust gas analysis equipment was assembled into an 18-foot van and dispatched to local airports where aircraft were leased and operated on the ground through a selected series of power settings while the exhaust was sampled and analyzed. Three runs were performed on each piston engine. Special fuel flow instrumentation was inserted in the aircraft fuel line to measure the fuel flow rate.

1.3 METHODOLOGY - TURBINE ENGINES

Gas turbine exhaust gas concentrations were analyzed by an exhaust emissions system set up in the control room of Test Cell 12 at NARF, Norfolk, Virginia. Heated sample lines were installed connecting the analysis equipment with a probe mounted behind the exhaust nozzle of the gas turbine engine under test. The engine was operated by Navy personnel who collected and made available the engine operating parameters such as fuel flow, thrust, throttle setting, etc. For the purpose of this project, the engines were operated at 75% power and normal (92%) power as well as the regular test cell settings of idle and military (100%) power.

1.4 OUTLINE OF REPORT

The report has been organized into seven sections following the introduction.

Section 2 describes the engines tested during this program and the sources of these engines.

Section 3 describes the equipment and procedures used in conducting the piston engine measurements.

Section 4 describes the equipment and procedures used in conducting the turbine engine measurements.

Section 5 describes piston engine data reduction, calculations used and presents the piston engine data acquired during this study.

Section 6 describes the turbine engine data reduction procedure, calculations used, and presents the turbine engine data acquired during this study.

Section 7 reports the results of the data analyses performed on the piston engine emission data and describes the techniques used to analyze the data, and Section 8 reports the results of turbine engine emission data analysis.

2.0 TEST ENGINES AND FUELS

Aircraft piston engines used in this program were obtained from local airport operators. The aircraft containing these engines were normally available for rent for pleasure flying, charter flights, pilot instruction or as air taxis. All were registered and licensed to fly. Engine models were selected to be representative of the most popular engines in use at present and in the near future. Specifications of the engine models tested are shown in Table 2.0-1. These models covered a wide range of horsepower and induction system design ranging from 100 hp carbureted models to 300 hp fuel injected and turbocharged models. Either regular airport 80 or 100 octane fuel was used for testing depending on the requirements of the engine.

The gas turbine engines tested during this program were those available at the Naval Air Rework Facility (NARF) Norfolk, Virginia. These are normally test cell qualified after overhaul and before being returned to fleet service. The Navy facility provided the engines in cooperation with EPA. The engines available were TF-30's, J-52's and J-57's, all non-afterburning engines, large quantities of which are currently in military service. Their designs are reflected in the design of present day commercial jet engines. NARF-supplied JP-5 fuel was used for all turbine testing and samples were collected for future reference.

Table 2.0-1

AIRCRAFT PISTON ENGINE MODELS TESTED

Engine Model	Manufacturer	Max. hp	Type	Quantity Tested	Total Runs
O-200	Continental	100	Normal Carburetion	7	21
O-320	Lycoming	160	Normal Carburetion	12	35
IO-360	Lycoming	200	Fuel Injection	4	13
IO-360	Continental	210	Fuel Injection	3	8
O-470	Continental	240	Normal Carburetion	2	5
IO-470	Continental	260	Fuel Injection	4	12
IO-520	Continental	300	Fuel Injection	3	9
O-540	Lycoming	260	Normal Carburetion	2	6
IO-540	Lycoming	300	Fuel Injection	4	12
					121

3.0 TEST EQUIPMENT AND PROCEDURES - PISTON ENGINES

3.1 DESCRIPTION OF SAMPLING AND ANALYTICAL EQUIPMENT

An 18-foot van was outfitted as an emissions laboratory. The gas analysis instrumentation consisted of MSA 300 NDIR analyzers for CO and CO_2, a Beckman Model 109A FID for hydrocarbons, a TECO chemiluminescence analyzer for NO and bubbler sampling apparatus for aldehydes. Aircraft engine fuel rate was measured with a Potter turbine meter on those engines which had a fuel pump and with a special fuel system with a Brooks rotameter in the fuel line for those aircraft that utilized gravity flow systems. Exhaust gas temperature at the sample probe inlet location was measured with a thermocouple. Continuous strip chart recordings were made of CO, CO_2, total hydrocarbons, NO, fuel flow rate, and exhaust gas temperature. Aldehyde bubbler samples were obtained during all steady state modes.

Stainless steel or Teflon plumbing was used throughout the sampling system. Stainless steel valves and fittings controlled the flow path and rate of sample gas as well as calibration gases. Sample conditioning was performed by a particulate filter, liquid trap and one coil refrigerated dryer before the sample entered the gas analyzers (see Figure 3.1-1). Zero and span gases were admitted to the analyzers through selector valves. Calibration gas standards were used for CO, CO_2, hydrocarbons, and nitric oxide.

The aldehyde apparatus consisted of two glass bubblers in series, wet test meter, and a vacuum pump. A measured volume of exhaust gas was

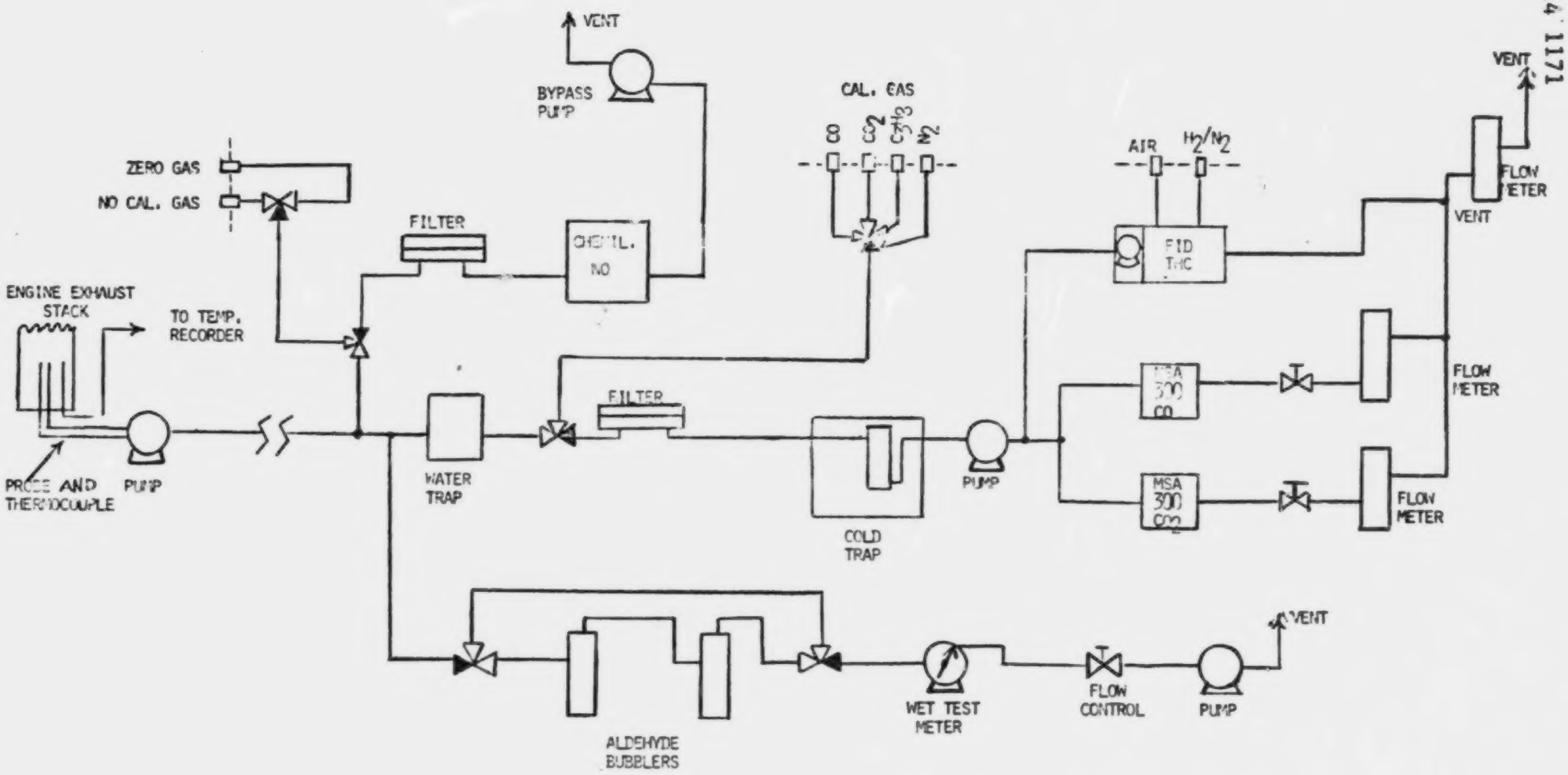

VENT
BYPASS PUMP
ZERO GAS
NO CAL. GAS
FILTER
CHEMIL. NO
CAL. GAS
CO
CO2
C3H8
N2
AIR
H2/N2
FID THC
VENT
FLOW METER
VENT
ENGINE EXHAUST STACK
TO TEMP. RECORDER
PROBE AND THERMOCOUPLE
PUMP
WATER TRAP
FILTER
COLD TRAP
PUMP
MSA 300 CO
MSA 300 CO2
FLOW METER
FLOW METER
ALDEHYDE BUBBLERS
WET TEST METER
FLOW CONTROL
PUMP
VENT

FIGURE 3.1-1 FLOW SCHEMATIC OF PISTON ENGINE EXHAUST GAS ANALYZER

bubbled through 0.06% sulfamic acid solution which retained the aldehydes. The liquid sample was then taken to the Scott Plumsteadville laboratory where the samples were analyzed by the MBTH method.

3.2 ENGINE TESTING PROCEDURES

Rented aircraft were positioned close to the emissions test van and the fuel flowmeter and the exhaust sample probe were attached to the fuel line and exhaust stack respectively. The exhaust sample probe was located as far up the exhaust stack as possible without being in a position to be influenced by the exhaust from individual engine cylinders. Propeller-blown air can enter the exhaust stack and dilute the sample. This problem is greatest at low engine speeds since as the engine speed increases, exhaust flow rate also increases.

After calibrating the exhaust gas analyzers, the system was set on sample and the engine started. Cold start tests included a three minute engine warm-up at 1000 rpm before switching to low idle, the first reported mode.

Table 3.2-1 illustrates the power settings and time in mode used for the different engine models tested. Power settings were those recommended in the aircraft operator's manual. Mixture control was set full rich in all modes as is normally done in low altitude operations. Continuous recordings were made and marked as the engine was run through the various modes: Idle, Taxi, Run-up, Take Off, Climb, Descent, Descent with Carburetor Heat (on normally aspirated engines), Approach and Final Taxi. Climb, Descent and Approach power settings were selected to approximate 75%, 65%, and 40% of full power. They did not reflect the actual power level that would be used in flight during

TABLE 3.2-1 PISTON ENGINE POWER SETTINGS

A/C Piston Engine Tests
Power Setting

Engine: Lycoming 0-320

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	N/A	-	3 min. (cold start)	Hot start go to Mode 2
2. Idle (low)	800		x	3 min.	
3. Idle/Taxi	1000		x	3 min.	
4. Run Up	1700		-	as required	Record data on left, right, and both mags.
5. Take Off	Full power		-	combination mode 2 min.	
6. Climb	Full power		x		
7. "Descent"	2000		x	2 min.	
7A. "Descent"	2000		x	2 min.	Carb. heat ON
8. "Approach"	1500		x	3 min.	
9. Taxi	1000		x	3 min.	
10. Shutdown	-		-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Lycoming IO-360

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (low)	800	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	2000	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full power	-	-	30 seconds	
6. Climb	2500	25	x	2 min. minimum	
7. "Descent"	2350	23	x	2 min.	
8. "Approach"	1900	20	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	x	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Lycoming 0-540

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (Low)	800	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	2000	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full Power	-	-	30 seconds	
6. Climb	2400	24	x	2 min.	
7. "Descent"	2300	23	x	2 min.	
7A. "Descent"	2300	23	x	2 min.	Carb. heat ON
8. "Approach"	1900	19	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	-	-	-

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Lycoming IO-540

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (low)	800	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	2000	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full power	-	-	30 seconds	
6. Climb	2400	24	x	2 min. minimum	
7. "Descent"	2300	22.5	x	2 min.	
8. "Approach"	1900	19	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Continental 0-200

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	N/A	-	3 min. (cold start)	Hot start go to Mode 2
2. Idle (low)	800	↓	x	3 min.	
3. Idle/Taxi	1000		x	3 min.	
4. Run Up	1700		-	as required	Record data on left, right and both mags.
5. Take Off	Full power		-	2 min. minimum - Combined mode	
6. Climb	Full power		x		
7. "Descent"	2000		x	2 min.	
7A. "Descent"	2000		x	2 min.	
8. Approach	1500		x	3 min.	
9. Taxi	1000		x	3 min.	
10. Shutdown	-		-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Continental IO-360

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (low)	800	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	1700	-	-	as required	Record data on left, right and both mags.
5. Take Off	Full power	-	-	30 seconds	
6. Climb	2600	24	x	2 min. minimum	
7. "Descent"	2400	22	x	2 min.	
8. "Approach"	2200	19	x	3 min.	
9. Taxi	1000	-	x	3 min	
10. Shutdown	-	-	-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Continental 0-470

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (low)	700	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	1700	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full Power	-	-	30 seconds	
6. Climb	2450	23	x	2 min. minimum	
7. "Descent"	2200	22	x	2 min.	
7A. "Descent"	2200	22	x	2 min.	Carb. heat ON
8. "Approach"	1800	22	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Continental IO-470

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle	700	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	1700	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full power	-	-	30 seconds	
6. Climb	2450	24	x	2 min. minimum	
7. "Descent"	2300	22	x	2 min.	
8. "Approach"	2100	17	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	-	-	

TABLE 3.2-1 (continued)

A/C Piston Engine Tests
Power Setting

Engine: Continental IO-520

Mode	rpm	Manif. Pres.	Sample Aldehydes	Approximate Time	Other
1. Start	1000	-	-	3 min.(cold start)	Hot start go to Mode 2
2. Idle (low)	700	-	x	3 min.	
3. Idle/Taxi	1000	-	x	3 min.	
4. Run Up	1700	-	-	as required	Record data on left, right, and both mags.
5. Take Off	Full power	-	-	30 seconds	
6. Climb	2550	25.0	x	2 min. minimum	
7. "Descent"	2200	22	x	2 min.	
8. "Approach"	1900	22.5	x	3 min.	
9. Taxi	1000	-	x	3 min.	
10. Shutdown	-	-	-	-	

those modes, but they do represent engine operation at high, medium and low power levels. When carburetor heat is applied, the engine rpm decreases. Throttle adjustment was used to return the rpm to the prescribed level for Descent mode.

Three runs through the test cycle were made on each engine, allowing sufficient time to cool the engine between runs. On a cold start the engine was warmed up for three minutes before the first measurement was made. On a hot start, measurements were begun immediately after reaching stable operation (about 30 seconds after start). On engines with dual exhaust, one cold and one hot start were made while sampling from one exhaust stack and one hot start while sampling from the other. Aircraft air-cooled engine cowlings are not designed for ground operation. Caution dictated careful monitoring of engine oil temperature and also cylinder head temperature where that instrument was available. Total operation time for one cycle did not exceed 25 minutes, of which less than one-third of that time was spent at power settings above fast idle. High engine temperature was experienced on two engines. The first occurrence was on a 100°F day. The second, also on a hot day, was while testing the rear engine of a push-pull twin engine aircraft where insufficient cooling air was drawn through the engine in ground operation. The engines were simply slowed to idle when rapidly increasing oil temperatures were noted and allowed to cool, then either the test was terminated or continued, depending on the engine's response to lower speed operation.

Services of certified aircraft mechanics were obtained from the airport operators who supplied the aircraft. The mechanics placed the fuel flowmeter in the fuel line and ran the engines through the test cycle. This provided competent, responsible engine operators and insured the aircraft owners that their engines were being properly treated.

Air temperature and relative humidity were measured before and after each run. Barometric pressure and engine tachometer time were logged at the beginning of each run. From the engine logbook, the total engine time and overhaul record (if applicable), as well as the engine's complete model number and manufacturer's serial number were obtained and recorded.

While the engine was being run through the test cycle, the strip chart records were marked to indicate the instrument ranges and test mode. Aldehyde samples were collected during all steady state modes. Approximately two liters of exhaust gas was bubbled through the sulfamic acid absorbing solution. Exhaust sample volume used for the aldehyde analysis was measured by a wet test meter. Wet test meter sample pressure, barometric pressure, and temperature were recorded and used to correct the sample volume. Engine operating data including rpm, manifold pressure and fuel type were logged on the test form.

3.3 CRANKCASE VENTILATION MEASUREMENTS

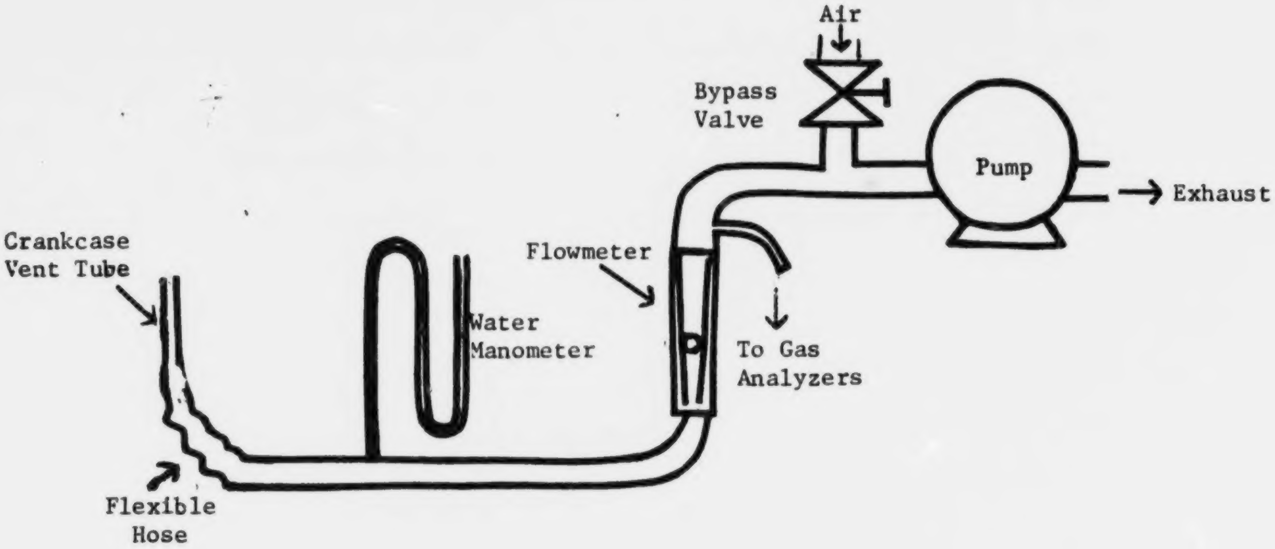
Crankcase ventilation emissions were measured on the last six piston engine aircraft tested during the program. The equipment consisted of two flowmeters (0-8 SCFM and 0-4 SCFM) connected in parallel, a water manometer, a vacuum pump with by-pass valve, and hoses to connect to the crankcase ventilation tube (see Figure 3.3-1).

Two flowmeters were required to increase the system's capacity when testing larger engines. These engines had more crankcase vent flow than could be handled by the 0-8 SCFM flowmeter alone.

In operation, the pressure at the outlet of the crankcase ventilation tube was brought to atmospheric by adjusting the by-pass valve of the vacuum pump. The flowmeter was read when the pressure equalized and an emission sample was then drawn into the emission analysis sytem, where CO, CO_2, NO and hydrocarbon concentrations were measured. These measurements were made at low idle, climb, descent, approach and taxi power in separate runs immediately following the regular exhaust emission run.

FIGURE 3.3-1

CRANKCASE VENTILATION EMISSIONS ANALYSIS SYSTEM


Air
Bypass Valve
Pump
Exhaust
Crankcase Vent Tube
Water Manometer
Flowmeter
To Gas Analyzers
Flexible Hose

PROCEDURE

1. Connect system to vent tube.

2. At each test condition bring the pressure at the crankcase vent tube outlet to ambient (as indicated on the water manometer) by adjusting the by-pass flow through the vacuum pump.

3. Record the flowmeter reading.

4. Flow sample of gas into emission analysis system.

4.0 TEST EQUIPMENT AND PROCEDURES - TURBINE ENGINES

4.1 INSTALLATION OF EQUIPMENT AT NARF, NORFOLK, VIRGINIA

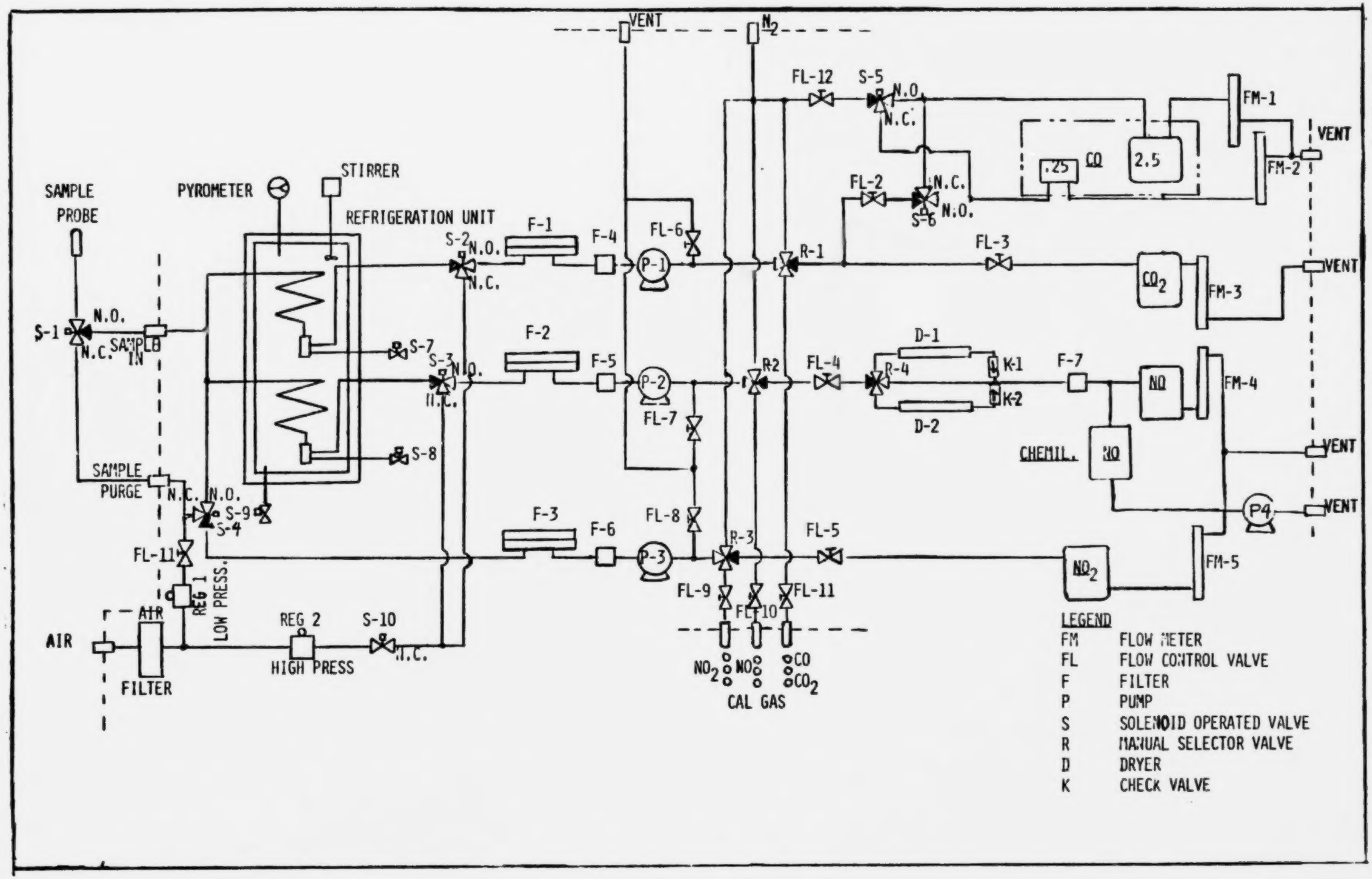
The analysis system was installed in the control room of Cell 12 at the Naval Air Rework Facility, Norfolk, Virginia. EPA-provided probes were attached by the Navy to the test cell exhaust tube behind the engine nozzle on the engine center line. Approximately 50 feet of 3/8 inch diameter stainless steel tubing was used to connect the probe to the analysis systems in the control room. In order to prevent condensation of the exhaust gases, this line was heated by six 400-watt strip heaters and insulated with asbestos tape. A heated particulate filter, located at the probe end of the line, was changed prior to the beginning of each run. A gate valve was located in the control room at the analyzer end of the line to relieve excessive line pressure when the turbine was operated at power settings above idle. The by-pass stream was dumped back into the test cell. Sample flow rate through the line therefore varied from the 16 liter per minute flow required by the analyzers to greater than 50 liters per minute when using the by-pass. The longest sample line transportation time was 2.4 seconds when no by-passing was done.

4.2 DESCRIPTION OF ANALYTICAL EQUIPMENT

The sample stream was divided into three streams, one flowing to the Scott Model 108-X Gas Analyzer, one stream to the Model 115 Heated Total Hydrocarbon Analyzer, and a third to the Aldehyde Bubbler Sampler System. The Scott Model 108X was a complete system for measuring CO, CO_2, NO and NO_2 (see Figure 4.2-1). Individual gas

FIGURE 4.2-1

FLOW SCHEMATIC FOR SRL 108-X


VENT
N_2
FL-12
S-5
N.O
N.C.
FM-1
FM-2
VENT
.25
CO
2.5
N.C.
FL-2
S-6
N.O.
SAMPLE
PROBE
PYROMETER
STIRRER
REFRIGERATION UNIT
S-2
N.O.
N.C.
F-1
F-4
FL-6
P-1
R-1
FL-3
CO_2
FM-3
VENT
S-1
N.O.
N.C.
SAMPLE
IN
S-7
S-3
N.O.
N.C.
F-2
F-5
P-2
R2
FL-4
R-4
D-1
K-1
K-2
D-2
F-7
NO
FM-4
FL-7
S-8
CHEMIL.
NO
VENT
SAMPLE
PURGE
N.C.
N.O.
S-9
S-4
P4
VENT
FL-11
F-3
F-6
FL-8
P-3
R-3
FL-5
NO_2
FM-5
REG 1
LOW PRESS.
FL-9
FL-10
FL-11
AIR
AIR
FILTER
REG 2
HIGH PRESS
S-10
N.C.
NO_2
NO
CO
CO_2
CAL GAS
LEGEND
FM FLOW METER
FL FLOW CONTROL VALVE
F FILTER
P PUMP
S SOLENOID OPERATED VALVE
R MANUAL SELECTOR VALVE
D DRYER
K CHECK VALVE

conditioning systems were used for each gas analyzer. The analyzers were Beckman NDIR for CO, CO_2 and NO, and Beckman NDUV for NO_2. Particulate filters protected each sample line. The samples to the CO, CO_2 and NO analyzers were conditioned in refrigerated coils to remove water vapor. Molecular sieve was also used for drying the NO sample stream to eliminate water vapor interference.

The NO sample line was divided after the sample conditioning system to provide the sample stream to the EPA-provided TECO chemiluminescence analyzer which served as an independent instrument for NO analysis.

The Scott Model 115 Heated Hydrocarbon Analyzer measured hydrocarbons as total carbon. This analyzer utilized a flame ionization detector and an extremely stable electrometer with a thermally controlled sample train to permit accurate measurements of low levels of the relatively high molecular weight hydrocarbons found in JP-5 fuel.

Aldehyde samples were collected by bubbling measured quantities of exhaust gas through 0.06% sulfamic acid and then analyzing for aldehydes as formaldehyde by the MBTH method.

All instruments were calibrated with precision calibration gases stored in cylinders. Gas flowmeters were used to monitor sample gas flow in each instrument. All instrument readings were recorded continuously on strip chart recorders. Aldehyde measurement data such as gas sample volume, wet test meter temperature and barometric pressure, and engine inlet temperature, relative humidity, and sample line temperature were kept in a hand written log.

4.3 ENGINE TESTING PROCEDURE - TURBINES

While the Navy crew completed the installation of a test engine, the Scott equipment was readied and calibrated. With the engine running, the strip charts were marked with the current instrument operating range in use and engine mode of operation using the same code as that used on the official Navy test cell log.

The engine logbook was examined and a complete record obtained of engine history. The parameters noted were: engine total time, time since hot section overhaul, turbine and compressor age, guide vane ring age, engine complete model number and manufacturers engine serial number.

5.0 DATA REDUCTION AND CALCULATIONS - PISTON ENGINES

5.1 DESCRIPTION OF EXHAUST EMISSION DATA REDUCTION

The piston exhaust emission data handling system was an integrated manual and computerized processing system with all calculations and conversion being done on the computer. Following are brief descriptions of each of the major segments of this system.

5.1.1 Manual Chart Reading and Data Preparation

The continuously recorded analog strip charts indicating carbon monoxide, carbon dioxide, total hydrocarbons, nitric oxide, exhaust gas temperature, and fuel flow were manually read and recorded on the run data sheets. In doing this, the initial transitionary segment of each mode was disregarded and the average reading for each mode recorded on a 0-100 scale. Where applicable, ranges and attenuations were also recorded. The recorded calibration data consisted of the following for both the pretest and post-test calibrations: zero readings, span readings, calibration standard gas concentrations, ranges, and attenuations. This data, having initially been recorded on the run data sheet by the field crew while calibrating, was checked against the strip charts and verified. This verification procedure helped keep calibration and conversion errors to a minimum. In addition, pertinent engine and test run data were recorded, verified, and coded by engine type. The data were then keypunched and key-verified for further processing.

5.1.2 Computerized Data Handling

The raw input data for a test run had been keypunched on five different types of data cards: piston engine data; test run data;

calibration data; mode data; and aldehyde data. The main processing program determined the type of data card, its order in the input deck, and processed it accordingly. The following subsections describe the processing done on each type of data card.

Piston Engine and Test Run Data

These cards contained the engine descriptive data such as: type, model, serial number, total engine time, time since major overhaul, and manufacturer; and general test conditions such as: type of start, fuel used, date, barometric pressure, dry bulb temperature, and wet bulb temperature. Using standard psychrometric equations, the relative humidity and the absolute inlet air humidity were calculated from the barometric pressure and the wet and dry bulb temperatures. All of these data were then stored in the Piston Test Data File.

Calibration Data

This card contained all the recorded calibration data for CO, CO_2, THC, and NO as mentioned in Section 5.1.1. The span readings for each parameter were corrected for zero shift and an average span value calculated over the total test runs. Using the average span values and the standard calibration concentrations, the calibration factors for each parameter were calculated and stored in memory. The calibration factors, average zero shifts, average span values, and standard ranges were printed out in an edit report for checking and verification. In the case of the CO and CO_2, where normalized curve functions were used, deviations from the standard calibration curve in excess of 5% were flagged with warning messages and appropriate diagnostic information.

In like manner, missing calibrations were also flagged. This calibration edit report enabled the data analyst to see any discrepancies at a glance, yet permitted the calibration factors to be machine calculated for each test with a high degree of accuracy and confidence. This method also permitted maximum usage of equipment in the field since the data conversion was not dependent on any specific instrument range or calibration standard.

Mode Data

The mode data cards contained the individual mode running conditions and the raw average readings and appropriate ranges or attenuations for the following parameters: fuel flow, exhaust gas temperature, CO, CO_2, THC, and NO. The raw readings were corrected for zero shift and, using the calculated calibration factor previously described, converted to concentration units. The type of fuel meter was determined by use of an input code and the raw fuel flow value converted to pounds per hour. Using the converted fuel flow, the fuel to air ratio and the air flow were calculated according to the following equations:

Air to Fuel Ratio:

$$AF = F_b \left[11.492 \; F_c \left(\frac{1 + {}^{R}/_{2}}{1 + R} \right) + \frac{120(1-F_c)}{3.5 + R} \right] + 0.34 + K_{THC}$$

$$F_b = \frac{P_{CO} + P_{CO_2}}{P_{CO} + P_{CO_2} + P_{THC}}$$

$$R = \frac{P_{CO}}{P_{CO_2}}$$

$$K_{THC} = 0.5 \text{ X } 10^{-4} \; (\text{ppm-}C_{THC} - 1000); \; 1000 < \text{ppm-}C_{THC} < 10{,}000$$

Fuel to Air Ratio:

$$FA = \frac{1}{AF}$$

Air Flow:

$$AIR = AF \times FUEL$$

where: AF = air to fuel ratio

F_b = fraction of fuel burned

P_x = percent concentration of pollutant in the exhaust

R = ratio of CO to CO_2 in the exhaust

F_c = fraction of carbon in fuel = 0.85 used for AV gas

K_{THC} = correction for high hydrocarbon concentrations.

FA = fuel to air ratio

AIR = air flow, pounds per hour

$FUEL$ = fuel flow, pounds per hour

The above air to fuel correction (K_{THC}) for high concentrations of total hydrocarbons is valid only for concentrations less than 1% carbon(Ref. 1). The correction is not necessary for concentrations less than 1000 ppm-C and no corrections were applied when THC concentrations were greater than 1% carbon. All of the above data was then loaded into the Piston Mode Data File.

Aldehyde Data

This card contained all the sampling information necessary to correct the sample volume for actual test conditions and calculate the total aldehyde concentration. This value was then stored in the Piston Mode Data File.

5.2 CRANKCASE VENTILATION DATA REDUCTION

Crankcase ventilation data consisted of gas concentrations and crankcase ventilation flow rates. The gas concentrations were scaled from the recorder charts using the appropriate instrument's calibration curve. A computer program written for a Wang calculator was used to calculate the mass emission rates of crankcase ventilation. The data was organized into tables and is presented in Appendix II. Included in the tables are engine mode, rpm, manifold pressure and fuel flow which were recorded during the crankcase ventilation measurements.

5.3 DESCRIPTION OF PISTON DATA

Tabular reports containing all the engine emission data, test run data, and mode data for each piston test run are contained in Appendix I. The data were stored on two index-sequential data files. The Piston Test File contains all the engine and test data as shown in Table 5.3-1. The Piston Mode File contains all the exhaust analysis data and operating conditions on a mode basis. Table 5.3-2 shows the parameters contained in this file. Each engine type was assigned a code which is located in the key for each record on the Test File. This enabled analysis to be done on all the runs of a given engine type with no reorganization or refiling. Both files are laid out sequentially by run number, the run number also providing the connecting link between the two files. There are a total of 1247 records in the Piston Mode File and 121 records in the Piston Test File.

Table 5.3-3 is a summary of all aircraft piston engines tested during this program listed in order of test. The code number at the left hand margin is composed of a three digit run number followed by

TABLE 5.3-1 PISTON TEST DATA FILE

Parameter		Description		
1	RUN	Test Run Number	xxx	
2	ENGIN	Engine Code Number	xxx	
3	PLANE	Plane Code Number	xx	
4	START	Type of Test Start	x	
5	MFGR	Engine Manufacturer	x(12)	
6	TYPE	Engine Type & Model	x(12)	
7	SERIAL	Engine Serial No.	x(18)	
8	TOTET	Total Engine Time	xxxxxx	hrs.
9	TSMOH	Time Since Major Engine Overhaul	xxxxxx	hrs.
10	FUEL	Type Fuel Used	x(12)	
11	JULDAY	Test Date - Julian Day	xxx	
12	BP	Average Barometric Pressure	xx.xx	in Hg
13	IAT	Average Inlet Air Temperature	xxx.x	°F
14	WBT	Average Wet Bulb Temperature	xxx.x	°F
15	RH	Average Relative Humidity	xxx	%
16	IAHUM	Average Inlet Air Humidity	x.xxxx	#H_2O/#Dry Air
17	BP1	Barometric Pressure - Test Start	xx.xx	in Hg
18	BP2	Barometric Pressure - Test Finish	xx.xx	in Hg.
19	IAT1	Inlet Air Temperature - Test Start	xxx.x	°F
20	IAT2	Inlet Air Temperature - Test Finish	xxx.x	°F

TABLE 5.3-2 PISTON MODE DATA FILE

Parameter		Description		
1	RUN	Test Run Number	xxx	
2	MODE	Test Mode Code	xxx	
3	LABEL	Mode Name	x(12)	
4	CARBHT	Carburetor Heat Status	xxxxxx	
5	PWR	% of Maximum Power Used	xxx	%
6	RPM	Engine Speed	xxxxxx	
7	IMP	Intake Manifold Pressure	xx.xx	in Hg
8	F/A	Calculated Fuel to Air Ratio	x.xxx	
9	AIR	Calculated Air Flow	xxxxxx	#/hr.
10	FUELF	Measured Fuel Flow	xxxxxx	#/hr.
11	EGT	Exhaust Gas Temperature	xxxxxx	°F
12	CO	Carbon Monoxide	xx.x	%
13	CO2	Carbon Dioxide	xx.x	%
14	THC	Total Hydrocarbons	xxxxx	ppm-C
15	NO	Nitric Oxide	xxxx	ppm
16	ALD	Total Aldehydes	xxxx	ppm

a three digit engine (type) number followed by a two digit plane number (the number of airplanes tested with this engine), followed by a letter indicating the type of start: C for cold and H for hot. Also tabulated, are the engine type and model number, engine serial number, total engine time, fuel used and which exhaust stack was sampled in the case of engines with dual exhaust.

TABLE 5.3-3 PISTON ENGINE TEST SUMMARY

RUN NO. ENGINE NO. PLANE NO. START	ENGINE TYPE AND MODEL		ENGINE SERIAL NO.	TOTAL ENGINE TIME	FUEL	STACK USED IF DUAL EXHAUST
00700261C	LYCOMING	IO 360 A/B	L-6967-51A	62	100 OCTANE	
00800201M	LYCOMING	IO-360-A/B	L-6967-51A	62.45	100 OCTANE	
00900201M	LYCOMING	IO 360 A/B	L-6967-51A	63	100 OCTANE	
01000102C	LYCOMING	O-320-A2B	26644	257	80 OCTANE	
01100102M	LYCOMING	O-320-A2B	26644	257.3	80 OCTANE	
01200102M	LYCOMING	O-320-A2B	26644	258	80 OCTANE	
01300103C	LYCOMING	O-320-E2D	L-23495-27A	526.73	80 OCTANE	
01400103M	LYCOMING	O-320-E2D	L-23495-27A	527.0	80 OCTANE	
01500103M	LYCOMING	O-320-E2D	L-23495-27A	527.3	80 OCTANE	
01600301M	CONTINENTAL	O-470-R	203247-70R	101.4	80 OCTANE	
01700301M	CONTINENTAL	O-470-R	203247-70R	101.7	80 OCTANE	
01800301M	CONTINENTAL	O-470-R	20347-70R	102.0	80 OCTANE	
01900401C	CONTINENTAL	O-200-A	204598-9-A	203.7	80 OCTANE	L
02000401M	CONTINENTAL	O-200-A	204598-9-A	204.0	80 OCTANE	L
02100401M	CONTINENTAL	O-200-A	204598-9-A	204.3	80 OCTANE	R
02200402C	CONTINENTAL	O-200-A	213378-71A	43.1	80 OCTANE	L
02300402M	CONTINENTAL	O-200-A	213378-71A	43.4	80 OCTANE	L
02400402M	CONTINENTAL	O-200-A	213378-71A	43.7	80 OCTANE	R
02500403C	CONTINENTAL	O-200-A	205317-9-A	209.1	80 OCTANE	L
02600403M	CONTINENTAL	O-200-A	205317-9-A	209.4	80 OCTANE	L
02700403M	CONTINENTAL	O-200-A	205317-9-A	209.7	80 OCTANE	R
02800104C	LYCOMING	O-320-E2D	L-24284-27A	09.8	80 OCTANE	
02900104M	LYCOMING	O-320-E2D	L-24284-27A	310.7	80 OCTANE	
03000104M	LYCOMING	O-320-E2D	L-24284-27A	310.9	80 OCTANE	
03100202C	LYCOMING	IO-360-A1B6	L-7482-51A	311.0	80 OCTANE	
03200202M	LYCOMING	IO-360-A1B6	L-7482-51A	808.5	80 OCTANE	
03300202M	LYCOMING	IO-360-A1B6	L-7482-51A	808.8	80 OCTANE	
03400105C	LYCOMING	O-320-E2D	L-28592-27A	809.1	80 OCTANE	
03500404C	CONTINENTAL	O-200-A	213 175-70-A	952.1	80 OCTANE	
03600404M	CONTINENTAL	O-200-A	213 175-70-A	952.4	80 OCTANE	
03700404M	CONTINENTAL	O-200-A	213 175-70-A	952.7	80 OCTANE	L
03800405C	CONTINENTAL	O-200-A	199590-9-A	714.1	80 OCTANE	L
03900405M	CONTINENTAL	O-200-A	199590-9-A	714.4	80 OCTANE	R
04000405M	CONTINENTAL	O-200-A	199590-9-A	714.7	80 OCTANE	L
04100406C	CONTINENTAL	O-200-A	199196-8-A	101.8	80 OCTANE	L
04200406M	CONTINENTAL	O-200-A	199196-8-A	971.0	80 OCTANE	R
04300406M	CONTINENTAL	O-200-A	199196-8-A	971.0	80 OCTANE	L
04400407C	CONTINENTAL	O-200-A	204579	971.0	80 OCTANE	L
04500407M	CONTINENTAL	O-200-A	204579	169.1	80 OCTANE	R
04600407M	CONTINENTAL	O-200-A	204579	169.4	80 OCTANE	
04700105C	LYCOMING	O-320-E2D	L-28592-27A	169.7	80 OCTANE	L
05000501C	CONTINENTAL	IO-470-V	170012-7-V-R	139.4	100 OCTANE	L
05100501M	CONTINENTAL	IO-470-V	170012-7-V-R	139.4	100 OCTANE	R
05200501M	CONTINENTAL	IO-470-V	170012-7-V-R	139.4	100 OCTANE	L
05300801C	CONTINENTAL	IO-360-C	F/51634-70C	1691	100 OCTANE	L
05400801M	CONTINENTAL	IO-360-C	F/51634-70C	1694	100 OCTANE	R
05500801M	CONTINENTAL	IO-360-C	F/51634-70C	1697	100 OCTANE	
05600106C	LYCOMING	O-320-E2A	L-26201-27A	1394	80 OCTANE	
05700106M	LYCOMING	O-320-E2A	L-26201-27A	1394	80 OCTANE	
05800106M	LYCOMING	O-320-E2A	L-26201-27A	1394	80 OCTANE	
05900107C	LYCOMING	O-320-E2A	L-27474-27A	1025	80 OCTANE	
06000107M	LYCOMING	O-320-E2A	L-27474-27A	1025	80 OCTANE	
06100107M	LYCOMING	O-320-E2A	L-27474-27A	1025	80 OCTANE	
06200108C	LYCOMING	O-320-E3D	L-29445-27A	54	80 OCTANE	
06300108M	LYCOMING	O-320-E3D	L-29445-27A	55	80 OCTANE	
06400108M	LYCOMING	O-320-E3D	L-29445-27A	55	80 OCTANE	
06500109C	LYCOMING	O-320-E2A	L-27848-27A	767	80 OCTANE	
06600109M	LYCOMING	O-320-E2A	L-27848-27A	768	80 OCTANE	
06700109M	LYCOMING	O-320-E2A	L-27848-27A	768	80 OCTANE	
06800601C	LYCOMING	IO-540-C4B5	L-6246-48	1747	100 OCTANE	
06900601M	LYCOMING	IO-540-C4B5	L-6246-48	1748	100 OCTANE	
07000601M	LYCOMING	IO-540-C4B5	L-6246-48	1748	100 OCTANE	
07100602C	LYCOMING	IO-540-C4B5	L-6239-48	1760	100 OCTANE	
07200602M	LYCOMING	IO-540-C4B5	L-6239-48	1761	100 OCTANE	
07300602M	LYCOMING	IO-540-C4B5	L-6239-48	1761	100 OCTANE	

RUN NO. ENGINE NO. PLANE NO. START	ENGINE TYPE AND MODEL		ENGINE SERIAL NO.	TOTAL ENGINE TIME	REBUILT ENGINE	FUEL	STACK USED IF DUAL EXHAUST
07400110C	LYCOMING	O-320-E2A	L-16364-27A	719.73		80 OCTANE	
07500110M	LYCOMING	O-320-E2A	L-16364-27A	719.94		80 OCTANE	
07600110M	LYCOMING	O-320-E2A	L-16364-27A	720.12		80 OCTANE	
07700502C	CONTINENTAL	IO-470-C	71018-7-C	760.5		100 OCTANE	L
07800502M	CONTINENTAL	IO-470-C	71018-7-C	760.8		100 OCTANE	L
07900502M	CONTINENTAL	IO-470-C	71018-7-C	761.1		100 OCTANE	R
08000204C	LYCOMING	IO-360-B1E	L-4835-51A	1179.3		100 OCTANE	F
08100204M	LYCOMING	IO-360-B1E	L-4835-51A	1179.5		100 OCTANE	F
08200204M	LYCOMING	IO-360-B1E	L-4835-51A	1179.7		100 OCTANE	B
08300111M	LYCOMING	O-320-E2A	L-29302-27A	129.47		80 OCTANE	
08400111M	LYCOMING	O-320-E2A	L-29302-27A	129.67		80 OCTANE	
08500111M	LYCOMING	O-320-E2A	L-29302-27A	129.86		80 OCTANE	
08600603C	LYCOMING	IO 540-C4B5	L-901-48	1318.0	YES	100 OCTANE	
08700603M	LYCOMING	IO 540-C4B5	L-901-48	1318.0	YES	100 OCTANE	
08800603M	LYCOMING	IO 540-C4B5	L-901-48	1318.5	YES	100 OCTANE	
08900604C	LYCOMING	IO-540-C4B5	L-1623-48	1304.3	YES	100 OCTANE	
09000604M	LYCOMING	IO-540-C4B5	L-1623-48	1304.5	YES	100 OCTANE	
09100604M	LYCOMING	IO-540-C4B5	L-1623-48	1304.7	YES	100 OCTANE	
09200701C	CONTINENTAL	IO-520-A	110140-3-A	1555.7		100 OCTANE	L
09300701M	CONTINENTAL	IO-520-A	110140-3-A	1555.9		100 OCTANE	L
09400701M	CONTINENTAL	IO-520-A	110140-3-A	1556.1		100 OCTANE	R
09500203M	LYCOMING	IO-360-A1A	L-2024-51A	1023.0		100 OCTANE	
09600203C	LYCOMING	IO-360-A1A	L-2024-51A	1023.3		100 OCTANE	
09700203M	LYCOMING	IO-360-A1A	L-2024-51A	1023.5		100 OCTANE	
09800203M	LYCOMING	IO-360-A1A	L-2024-51A	1023.8		100 OCTANE	
09900902C	CONTINENTAL	IO-360-C	50591-6-C	700		100 OCTANE	R
10000902M	CONTINENTAL	IO-360-C	50591-6-C	700		100 OCTANE	R
10100902M	CONTINENTAL	IO-360-C	50591-6-C	700		100 OCTANE	R
10200902M	CONTINENTAL	IO-360-C	50591-6-C	700		100 OCTANE	L
10300903C	CONTINENTAL	IO-360-C	55451-6-D	700		100 OCTANE	L
10400702M	CONTINENTAL	TS-IO-520-E	206191-9-E	213.0		100 OCTANE	
10500702C	CONTINENTAL	TS-IO-520-E	206191-9-E	213.0		100 OCTANE	
10600702M	CONTINENTAL	TS-IO-520-E	206191-9-E	213.0		100 OCTANE	
10700703C	CONTINENTAL	TS-IO-520-E	206211-9-E	213.0		100 OCTANE	
10800703M	CONTINENTAL	TS-IO-520-E	206211-9-E	213.0		100 OCTANE	
10900703M	CONTINENTAL	TS-IO-520-E	206211-9-E	213.0		100 OCTANE	
11000901C	LYCOMING	O-540-A1B5	L-3141-48	1133		100 OCTANE	R
11100901M	LYCOMING	O-540-A1B5	L-3141-48	1133		100 OCTANE	R
11200901M	LYCOMING	O-540-A1B5	L-3141-48	1133		100 OCTANE	R
11300902C	LYCOMING	O-540-A1B5	L-3454-48	932	YES	100 OCTANE	L
11400902M	LYCOMING	O-540-A1B5	L-3454-48	932	YES	100 OCTANE	L
11500902M	LYCOMING	O-540-A1B5	L-3454-48	932	YES	100 OCTANE	L
11600503M	CONTINENTAL	IO-470-VO	149863VO	104.7		100 OCTANE	R
11700503M	CONTINENTAL	IO-470-VO	149863VO	105		100 OCTANE	L
11800503C	CONTINENTAL	IO-470-VO	149863VO	105		100 OCTANE	L
11900504C	CONTINENTAL	IO 470-VO	49055VO	105		100 OCTANE	R
12000504M	CONTINENTAL	IO 470-VO	49055VO	105		100 OCTANE	R
12100504M	CONTINENTAL	IO 470-VO	49055VO	105		100 OCTANE	L
12200112C	LYCOMING	O-320-B3B	L-4393-39	563		100 OCTANE	
12300112M	LYCOMING	O-320-B3B	L-4393-39	563		100 OCTANE	
12400112M	LYCOMING	O-320-B3B	L-4393-39	563		100 OCTANE	L
12500113C	LYCOMING	O-320-B3B	L-4334-39	433		100 OCTANE	R
12600113M	LYCOMING	O-320-B3B	L-4334-39	433		100 OCTANE	R
12700113M	LYCOMING	O-320-B3B	L-4334-39	433		100 OCTANE	
12800302C	CONTINENTAL	O-470-R	133510-6-R	69	YES	80 OCTANE	
12900302M	CONTINENTAL	O-470-R	133510-6-R	69	YES	80 OCTANE	

6.0 DATA REDUCTION AND CALCULATIONS - TURBINE ENGINES

6.1 DESCRIPTION OF TURBINE DATA REDUCTION

The turbine exhaust data were reduced using a combination of manual and computer processing techniques. The following are brief descriptions of the major segments of this system.

6.1.1 Manual Chart Reading and Data Preparation

The continuously recorded analog strip charts indicating carbon dioxide, carbon monoxide, total hydrocarbons, nitrogen dioxide and nitric oxide (measured both by NDIR and chemiluminescence techniques) were manually read and recorded on run data sheets. In doing so, the initial transition segment of each mode was disregarded and equilibrium reading for each mode was recorded along with the applicable instrument range or attenuation. The recorded calibration data consisting of zero readings, span readings, calibration gas concentration and instrument range, from the pre-test and post-test calibration was entered on the run data sheets. In addition, pertinent engine history and test run data was recorded. The analog chart readings were then converted to gas concentrations using the appropriate instrument calibration curve. The gas concentrations including the aldehyde concentrations, and all other test run data, were then keypunched and key-verified for further processing.

6.1.2 Computerized Data Handling

The raw input data was punched on four different types of data cards: turbine engine data; test run data; mode data; and aldehyde data. The main processing program determined the type of data card, its order in the input deck, and processed it accordingly.

The following subsections describe the processing on each type of data card:

Turbine Engine and Test Run Data

These cards contained the engine descriptive data such as: type and nozzle, serial number, total engine time, time since overhaul of the various parts, and general test conditions such as: type of fuel used, date, barometric pressure, dry bulb temperature, and wet bulb temperature. Using standard psychrometric equations, the relative humidity and the absolute inlet air humidity were calculated from the barometric pressure and the wet and dry bulb temperatures. All of these data were then stored in the Turbine Test File.

Mode Data

The mode data cards contained the individual mode running conditions for fuel flow, exhaust gas temperature and pressure, inlet temperature and pressure and the gas concentration readings for CO, CO_2, THC, NO, and NO_2. These data were fed into a file utilized in the calculation of: fuel-air ratio, air flow, and the conversion factor used to convert dry concentrations to wet concentrations. All the above data were then loaded into the Turbine Mode File.

Aldehyde Data

This card contained all the sampling information necessary to correct the sample volume for actual test conditions and calculate the total aldehyde concentration. The value was then stored in the Turbine Mode File.

6.2 CONVERSION OF CONCENTRATIONS (DRY) TO WET BASIS

Gas concentrations of CO, CO_2 and NO measured by NDIR were measured "dry". The sample conditioning systems used for these instruments removes most of the water vapor. To report these exhaust gas values as "wet" values, that is the ratio by volume of the specific gas to all gases, a calculation was performed based on carbon balance and an assumed hydrogen to carbon ratio of the JP-5 fuel used. The equations used were those specified in Reference 2.

Concentration (wet basis) = K_w Concentration (dry basis)

$$K_w = K_d \frac{200 - y(1 + \frac{\alpha}{2})}{200 - y + \frac{K_d\ y\alpha}{2}\ (1 - \frac{CO}{10^6})}$$

$$K_d = \frac{100}{100 + \frac{\alpha}{2}\ (\frac{CO}{10^4} + CO_2)}$$

where: CO = concentration of CO in exhaust, ppm

CO_2 = concentration of CO_2 in exhaust, %

y = water content of intake air (% by volume)

α = (atomic) hydrogen - carbon ratio of fuel (assumed to be 2)

Fuel to air ratio was calculated using the equation recommended by the SAE E-31 committee. The equation is:

$$F/A = .485 \frac{(\frac{CO}{10^4} + CO_2)(1 + \frac{\alpha C}{2 \cdot 10^6} + \frac{C}{10^4}}{100 + \frac{CO}{10^4}\ (\frac{\alpha}{4} - \frac{1}{2}) + \frac{\alpha}{4}\ CO_2}$$

where the symbols used are the same as the preceeding, and C = concentration of hydrocarbons in the exhaust, ppm-C. The CO and CO_2 are the exhaust concentrations of those gases measured on a dry basis and the C is the exhaust hydrocarbon concentration measured on a wet basis.

The air flow rate was calculated using the measured fuel flow rate and the fuel to air ratio calculated above.

6.3 DESCRIPTION OF TURBINE DATA

Tabulations of all the turbine emissions data, test run data, and mode data for each turbine test run are contained in Appendix III. The data from which these tables were generated have been stored on two index sequential computer files. One file called the Turbine Test File contains all the engine and test data as shown in Table 6.3-1. Table 6.3-2, the Turbine Mode File, contains all the exhaust analysis data and operating conditions on a mode basis. Each engine type was assigned a code which is located in the key for each record on the test file. This enables analysis to be done on all the runs of given engine type with no reorganization or refiling. Both files are laid out sequentially by run number with the run number providing the connecting link between the two files. There are a total of 108 records in the Turbine Mode File and 26 records in the Turbine Test File. Table 6.3-3 is a listing of Scott run numbers, engine type and NARF sequence numbers to which they apply.

TABLE 6.3-1 TURBINE TEST DATA FILE

Parameter		Description		
1	RUN	Test Run Number	xxx	
2	ENGIN	Engine Code Number	xxx	
3	COPY	Engine Copy Code Number	xx	
4	TYPE	Engine Type & Model	x(12)	
5	SERIAL	Engine Serial Number	x(12)	
6	TOTET	Total Engine Time	xxxxxx	hrs.
7	TSMOH	Time Since Major Overhaul	xxxxxx	hrs.
8	N1OH	Time Since N1 Compressor Overhaul	xxxxxx	hrs.
9	N2OH	Time Since N2 Compressor Overhaul	xxxxxx	hrs.
10	CCR	Time Since Combustion Can Replacement	xxxxxx	hrs.
11	NOZOH	Time Since Nozzle Overhaul	xxxxxx	hrs.
12	NITOH	Time Since N1 Turbine Overhaul	xxxxxx	hrs.
13	N2TOH	Time Since N2 Turbine Overhaul	xxxxxx	hrs.
14	FUEL	Type Fuel Used	xxxxxx	
15	SLT	Sample Line Temperature	xxxx	°F
16	PROBE	Type Probe Used	x(18)	
17	JULDAY	Test Date - Julian Day	xxx	
18	BP	Average Barometric Pressure	xx.xx	in Hg
19	IAT	Average Inlet Air Temperature	xxx.x	°F
20	WBT	Average Wet Bulb Temperature	xxx.x	°F
21	RH	Average Relative Humidity	xxx	%
22	IAHUM	Average Inlet Air Humidity	x.xxxx	#H_2O/#Dry Air
23	BP1	Barometric Pressure - Test Start	xx.xx	in Hg
24	TP2	Barometric Pressure - Test Finish	xx.xx	in Hg
25	IAT1	Inlet Air Temperature - Test Start	xxx.x	°F
26	IAT2	Inlet Air Temperature - Test Finish	xxx.x	°F

TABLE 6.3-2 TURBINE MODE DATA FILE

Parameter		Description		
1	RUN	Test Run Number	xxx	
2	MODE	Test Mode Code	xxx	
3	LABEL	Mode Name	x(12)	
4	THRUST	Engine Thrust	xxxxxx	#
5	PWR	% Maximum Power	xxx	%
6	N1RPM	RPM - N1 Turbine	xxxxxx	
7	N2RPM	RPM - N2 Turbine	xxxxxx	
8	F/A	Calculated Fuel to Air Ratio	x.xxx	
9	AIR	Calculated Air Flow	xxxxxx	#/hr.
10	FUELF	Fuel Flow	xxxxxx	#/hr.
11	EPR	Exhaust Pressure Ratio	x.xxx	
12	EGP	Exhaust Gas Pressure	xx.xx	in Hg
13	EGT	Exhaust Gas Temperature	xxxxx	^{o}F
14	CO	Carbon Monoxide	xxxx	ppm
15	CO2	Carbon Dioxide	xx.xx	%
16	THC	Total Hydrocarbons	xxxxx.x	ppm-C
17	NO	Nitric Oxide	xxx.x	ppm
18	NO2	Nitrogen Dioxide	xxx.x	ppm
19	CNO	Nitric Oxide - Chemiluminescent	xxx.x	ppm
20	ALD	Total Aldehydes	xxx.x	ppm
21	WCO	Carbon Monoxide - Wet	xxxx	ppm
22	WCO2	Carbon Dioxide - Wet	xx.xx	%
23	WNO	Nitric Oxide - Wet	xxx.x	ppm
24	WCNO	Nitric Oxide(Chemiluminescent) - Wet	xxx.x	ppm

TABLE 6.3-3 TURBINE ENGINE TEST SUMMARY

SRL Run No.	NARF Seq. No.	Date Tested	Engine Type
T001	291	30 June	TF30-P6C
T002	324	2 July	J57-P10
T003	327	6 July	J57-P10
T004	308	7 July	J57-P10
T005	312	7 July	TF30-P408
T006	852	8 July	J52-P8A
T007	394	9 July	TF30-P6C
T008	67R/H	8 July	J52-P8B
T009	305	9 July	TF30-P6C
T010	871	12 July	J57-P10
T011	311	13 July	TF30-P408
T012	332	14 July	TF30-P408
T013	351	15 July	J57-P10
T014	163	16 July	TF30-P408
T015	885	16 July	J57-P10
T016	72L/H	19 July	J52-P8A
T017	333	19 July	TF30-P6C
T018	352	20 July	TF30-P408
T019	308	20 July	J57-P10
T020	369	22 July	J57-P10
T021	277	22 July	TF30-P8B analytical
T022	879	23 July	TF30-P6B
T023	418	26 July	TF30-P8
T024	375	27 July	TF30-P408
T025	898	28 July	J52-P6A
T026	73R/H	28 July	J52-P8M

7.0 DATA ANALYSIS - PISTON ENGINES

Mass emission rates were calculated and organized into data files which were analyzed in order to determine: the engine-to-engine variation in emissions for each engine model tested, the differences in emissions between hot starts and cold starts, and the dependence of emissions on engine power setting and air/fuel ratio. Multiple linear regression analyses were performed to determine the effect of air/fuel ratio, exhaust gas temperature, brake horsepower, brake specific fuel consumption and humidity on mass emission rates.

7.1 PISTON ENGINE MASS EMISSION CALCULATIONS

Mass emission rates on a pound per pound of fuel and on a pound per minute basis were calculated using a carbon balance technique. The equation used to calculate the emission per pound of fuel was:

$$\frac{\text{lb X}}{\text{lb fuel}} = \frac{P_x\ (MW_x)}{(P_{CO} + P_{CO_2} + P_{HC\text{-}C})\ (MW_{fuel})}$$

where: P_x = exhaust concentration of X expressed as a mole fraction

$$P_{CO} = \frac{\text{concentration of CO,(\%)}}{100}$$

$$P_{CO_2} = \frac{\text{concentration of CO,(\%)}}{100}$$

$$P_{HC\text{-}C} = \frac{\text{concentration of HC (ppm-C)}}{10^6}$$

$(MW)_x$ = molecular weight of X

$(MW)_{fuel}$ = empirical molecular weight of fuel

Molecular weights:

CO = 28 HC = 13.85 NO_x = 46

CO_2 = 44 fuel = 14.12 HCHO = 30

The molecular weight of hydrocarbon is based on the Federal Register value of 16.33 grams/cu.ft. used in CVS calculations and is characterized by the formula $CH_{1.85}$.

The empirical molecular weight of the fuel was calculated as:

$$(MW)_{fuel} = 12\ (1 + \frac{H}{C}\ \text{mass ratio})$$

A $\frac{H}{C}$ mass value of .1765 was used for 80 and 100 octane aviation gasoline.

The mass emission rate was then calculated using the fuel flow rate:

$$\frac{\text{lb X}}{\text{min.}} = \frac{\text{lb X}}{\text{lb fuel}} \cdot \frac{\text{lb fuel}}{\text{min.}}$$

The calculated piston engine mass emission values were combined with the exhaust concentration data and the engine and test run data. All of the data for each run are presented on a separate page of Appendix I. No mass emission calculations were possible when either total hydrocarbons, carbon dioxide, or carbon monoxide data was missing. When fuel flow data were missing, mass emissions on a pound per pound basis were possible but not on a pound per minute basis.

7.2 ANALYSIS OF ENGINE-TO-ENGINE VARIATIONS

Statistical analyses were performed to establish the nominal levels and engine-to-engine variations of emissions for each model engine tested. Means, standard deviations and coefficients of variation were computed for each mode and pollutant, and a computer test for outliers was performed. The outliers named by the computer were studied to determine their cause. Outliers fell into the following three categories:

1. Variations from the population mean due to the way the engine parameters had been adjusted.
2. Discrepancies in a run or part of a run caused by the engine operator not matching the required test power settings or incorrectly operating the engine. (carburetor heat applied in the wrong mode, running the engine on one magneto only, etc.).
3. Incorrect data arising from instrumental error or incorrect logging.

Outliers arising from the latter two causes were discarded as bad data points. However, outliers due to the first cause, engine adjustment, were allowed to remain, because even though the engine emissions differed from the mean by an appreciable amount, still the engine was in daily service and it was therefore representative of an engine in the general aviation fleet. Out of 86 outliers examined, only 21 were judged caused by operator or instrument error and discarded.

The outlier test, a standard Scott statistical program, computes means and standard deviations, tests for outliers, removes the outliers and recomputes the mean and standard deviations. A subroutine lists the outliers along with the number of observations, maximum value, minimum value, mean and standard deviations. A more complete description of the outlier test package is contained in Appendix IV.

7.2.1 Engine-to-Engine Variations Within Engine Model

The mass emissions data calculated for the nine engine models tested are presented in Tables 7.2-1 through 7.2-9. For each model,

TABLE 7.2-1

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : CONTINENTAL O-200 TEST START : HOT & COLD

	MODE	NO. OF OBS	------------- #/# FUEL			------------	
			MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
CO:							
	IDLE (LOW)	21	1.03061	.47960	.82028	.14486	17.66
	IDLE TAXI	21	1.12625	.65501	.93065	.14394	15.47
	TAKE OFF	20	1.23431	1.05709	1.14424	.05443	4.76
	CLIMB	20	1.23431	1.05709	1.14424	.05443	4.76
	DESCENT	19	.98063	.82679	.89018	.04270	4.80
	DESCENT ON	21	1.33847	1.14692	1.24569	.05759	4.62
	APPROACH	20	1.17454	1.03645	1.10508	.03632	3.29
	TAXI	20	1.15229	.74185	.96955	.12016	12.39
CO2:							
	IDLE (LOW)	21	2.24384	1.19215	1.68064	.26232	15.61
	IDLE TAXI	21	2.01590	1.20129	1.58064	.23422	14.82
	TAKE OFF	20	1.41575	1.12568	1.27276	.09162	7.20
	CLIMB	20	1.41575	1.12568	1.27276	.09162	7.20
	DESCENT	19	1.78044	1.54099	1.67835	.06702	3.99
	DESCENT ON	21	1.23914	.91698	1.08907	.08735	8.02
	APPROACH	20	1.43088	1.21778	1.33057	.05754	4.32
	TAXI	20	1.88316	1.27070	1.53374	.18891	12.32
THC :							
	IDLE (LOW)	21	.09448	.01664	.04554	.01703	37.40
	IDLE TAXI	21	.05205	.01183	.02279	.00849	37.23
	TAKE OFF	20	.01843	.00297	.01255	.00415	33.07
	CLIMB	20	.01843	.00297	.01255	.00415	33.07
	DESCENT	19	.01510	.00500	.01090	.00292	26.82
	DESCENT ON	21	.05953	.00824	.02171	.01221	56.25
	APPROACH	21	.01952	.00659	.01528	.00341	22.31
	TAXI	20	.02758	.01020	.01838	.00458	24.94
NOX (NO2):							
	IDLE (LOW)	21	.00222	.00009	.00059	.00045	75.03
	IDLE TAXI	20	.00173	.00042	.00116	.00037	31.91
	TAKE OFF	20	.00798	.00161	.00379	.00184	48.55
	CLIMB	20	.00798	.00161	.00379	.00184	48.55
	DESCENT	19	.01101	.00252	.00614	.00241	39.21
	DESCENT ON	21	.01250	.00000	.00379	.00321	84.77
	APPROACH	21	.00550	.00118	.00233	.00126	54.35
	TAXI	20	.00280	.00097	.00143	.00045	31.82
ALD (HCHO):							
	IDLE (LOW)	21	.00048	.00008	.00032	.00010	31.28
	IDLE TAXI	21	.00035	.00011	.00021	.00006	31.22
	TAKE OFF						
	CLIMB	20	.00031	.00005	.00012	.00006	50.00
	DESCENT	19	.00038	.00006	.00013	.00007	52.24
	DESCENT ON	21	.00035	.00003	.00012	.00007	59.20
	APPROACH	21	.00020	.00005	.00011	.00004	34.04
	TAXI	19	.00022	.00006	.00013	.00004	28.89

TABLE 7.2-2

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : LYCOMING O-320
                                                              TEST START : HOT & COLD

                                          ------------- #/# FUEL ------------

                  MODE          NO. OF      MAX         MIN        MEAN       STND       %COEF
                                 OBS       VALUE       VALUE                   DEV        VAR
      CO:
               IDLE (LOW)        28       1.09618      .30991     .68004     .20718      30.47
               IDLE TAXI         28       1.20749      .42031     .84451     .22350      26.47
               TAKE OFF          27       1.21519      .91061    1.09682     .08493       7.74
               CLIMB             26       1.21519      .91061    1.10091     .08387       7.62
               DESCENT           28       1.16717      .65934     .90165     .15136      16.79
               DESCENT ON        28       1.34123      .67989     .99614     .21149      21.23
               APPROACH          28       1.16934      .72916     .98949     .13550      13.69
               TAXI              28        .96637      .38671     .67428     .18192      26.98
     CO2:
               IDLE (LOW)        28       2.51062     1.18940    1.96493     .34048      17.33
               IDLE TAXI         28       2.42177     1.09230    1.72623     .37223      21.56
               TAKE OFF          27       1.64083     1.06204    1.34013     .15084      11.26
               CLIMB             26       1.64083     1.06204    1.33329     .14948      11.21
               DESCENT           28       2.04592     1.23278    1.65871     .24016      14.48
               DESCENT ON        28       2.02025      .91621    1.49764     .35362      23.61
               APPROACH          28       1.92900     1.21347    1.50642     .22171      14.72
               TAXI              28       2.45719     1.54570    2.01040     .29088      14.47
THC       :
               IDLE (LOW)        28        .06341      .01348     .02574     .01013      39.36
               IDLE TAXI         28        .06098      .01066     .01962     .00976      49.74
               TAKE OFF          28        .06687      .00900     .01614     .01138      70.53
               CLIMB             28        .06687      .00900     .01602     .01143      71.36
               DESCENT           28        .01635      .00882     .01272     .00200      15.70
               DESCENT ON        28        .03434      .00868     .01662     .00725      43.60
               APPROACH          28        .02249      .01157     .01714     .00330      19.23
               TAXI              28        .02077      .00946     .01446     .00312      21.56
NOX (NO2):
               IDLE (LOW)        25        .00210      .00013     .00082     .00050      60.46
               IDLE TAXI         25        .00272      .00013     .00102     .00065      63.41
               TAKE OFF          21        .00451      .00015     .00151     .00117      77.62
               CLIMB             22        .00451      .00015     .00158     .00123      77.76
               DESCENT           24        .01295      .00070     .00480     .00420      87.55
               DESCENT ON        24        .01245      .00033     .00501     .00370      73.83
               APPROACH          23        .00372      .00078     .00203     .00100      49.29
               TAXI              24        .00410      .00063     .00171     .00106      61.60
ALD (HCHO):
               IDLE (LOW)        28        .00045      .00011     .00024     .00009      37.14
               IDLE TAXI         27        .00040      .00007     .00017     .00008      48.94
               TAKE OFF
               CLIMB             28        .00037      .00004     .00011     .00007      58.65
               DESCENT           28        .00021      .00003     .00009     .00004      40.55
               DESCENT ON        25        .00016      .00004     .00009     .00004      40.90
               APPROACH          27        .00024      .00004     .00011     .00005      44.42
               TAXI              28        .00041      .00005     .00015     .00008      52.62
```

TABLE 7.2-3

SCOTT RESEARCH LABORATORIES   SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : CONTINENTAL 0-470   TEST START : HOT & COLD

	MODE	NO. OF OBS	------------- #/# FUEL ------------ MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
CO:							
	IDLE (LOW)	5	.98283	.80215	.89163	.06837	7.67
	IDLE TAXI	5	1.07534	.78582	.91659	.13713	14.96
	TAKE OFF	4	1.00915	.09332	.76551	.44834	58.57
	CLIMB	5	1.00616	.06873	.58089	.33406	57.51
	DESCENT	5	.69640	.41288	.61441	.11502	18.72
	DESCENT ON	4	1.25575	1.18681	1.21718	.02897	2.38
	APPROACH	3	.80587	.73068	.77628	.04007	5.16
	TAXI	4	1.11265	.72012	.83966	.18576	22.12
CO2:							
	IDLE (LOW)	5	1.53340	.61368	1.12605	.46737	41.51
	IDLE TAXI	5	1.84216	1.18123	1.55978	.31672	20.31
	TAKE OFF	4	2.93290	1.49571	1.87698	.70425	37.52
	CLIMB	5	2.98082	1.50491	2.18033	.52527	24.09
	DESCENT	5	2.43302	2.00631	2.12925	.17338	8.14
	DESCENT ON	4	1.21795	1.08873	1.16195	.05407	4.65
	APPROACH	3	1.94613	1.82505	1.87265	.06456	3.45
	TAXI	4	1.94889	1.12286	1.70970	.39576	23.15
THC (CH4):							
	IDLE (LOW)	5	.38488	.05152	.18260	.17258	94.51
	IDLE TAXI	5	.07608	.01228	.03610	.03170	87.82
	TAKE OFF	4	.01207	.01089	.01138	.00052	4.61
	CLIMB	5	.00949	.00533	.00728	.00175	24.00
	DESCENT	5	.01079	.00492	.00679	.00244	35.85
	DESCENT ON	4	.01692	.01045	.01301	.00278	21.40
	APPROACH	3	.00782	.00691	.00748	.00050	6.64
	TAXI	4	.07601	.00985	.02710	.03261	120.33
NOX (NO2):							
	IDLE (LOW)	5	.00031	.00005	.00018	.00012	60.37
	IDLE TAXI	5	.00110	.00014	.00066	.00047	70.69
	TAKE OFF	4	.07186	.00068	.01975	.03476	176.04
	CLIMB	5	.09498	.00052	.02078	.04150	199.66
	DESCENT	5	.05051	.00169	.01187	.02161	182.09
	DESCENT ON	4	.00044	.00029	.00038	.00007	18.55
	APPROACH	3	.00518	.00252	.00344	.00151	43.83
	TAXI	4	.00116	.00010	.00072	.00046	64.42
ALD (HCHO):							
	IDLE (LOW)	5	.00041	.00037	.00039	.00002	4.56
	IDLE TAXI	5	.00030	.00016	.00023	.00006	28.32
	TAKE OFF						
	CLIMB	5	.00018	.00007	.00011	.00004	36.49
	DESCENT	5	.00015	.00004	.00009	.00005	56.15
	DESCENT ON	4	.00007	.00001	.00004	.00003	55.92
	APPROACH	3	.00020	.00003	.00011	.00009	80.83
	TAXI	4	.00019	.00003	.00010	.00008	82.64

TABLE 7.2-4

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : LYCOMING 0-540 TEST START : HOT & COLD

	MODE	NO. OF OBS	MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
			#/# FUEL				
CO:							
	IDLE (LOW)	6	.84173	.35057	.60661	.16579	27.33
	IDLE TAXI	6	.90109	.59021	.73720	.12873	17.46
	TAKE OFF	6	1.00000	.74946	.92731	.09083	9.79
	CLIMB	6	.99722	.57203	.81095	.16754	20.66
	DESCENT	6	.74818	.49923	.62849	.10998	17.50
	DESCENT ON	6	1.26447	1.21053	1.23716	.02037	1.65
	APPROACH	6	1.39653	.82201	.98817	.20621	20.87
	TAXI	6	.92593	.49301	.76670	.17746	23.14
CO2:							
	IDLE (LOW)	6	2.17732	1.46739	1.87741	.30107	16.04
	IDLE TAXI	6	2.11993	1.55560	1.82552	.23029	12.61
	TAKE OFF	6	1.90871	1.39603	1.59546	.16914	10.60
	CLIMB	6	2.19414	1.50231	1.79033	.27940	15.61
	DESCENT	6	2.24144	1.88094	2.00249	.16988	8.16
	DESCENT ON	6	1.13087	1.05165	1.09447	.02890	2.64
	APPROACH	6	1.70037	.81695	1.49496	.33748	22.57
	TAXI	6	2.28604	1.49233	1.77166	.31962	18.04
THC :							
	IDLE (LOW)	6	.14513	.03804	.08860	.04226	47.70
	IDLE TAXI	6	.07008	.02146	.04106	.01712	41.70
	TAKE OFF	6	.04597	.00937	.01983	.01364	68.77
	CLIMB	6	.03471	.00693	.01610	.00964	59.86
	DESCENT	6	.02810	.00816	.01442	.00739	51.26
	DESCENT ON	6	.05042	.01609	.02419	.01299	53.70
	APPROACH	6	.03820	.01154	.02133	.01128	52.89
	TAXI	6	.06706	.01692	.04339	.01885	43.44
NOX (NO2):							
	IDLE (LOW)	6	.00076	.00019	.00046	.00024	52.97
	IDLE TAXI	6	.00122	.00044	.00077	.00028	36.93
	TAKE OFF	6	.00706	.00363	.00507	.00131	25.82
	CLIMB	6	.04189	.00302	.01895	.01442	76.10
	DESCENT	6	.02648	.01715	.02211	.00384	17.37
	DESCENT ON	6	.00437	.00189	.00268	.00091	33.89
	APPROACH	6	.00558	.00057	.00392	.00180	45.75
	TAXI	6	.00206	.00061	.00112	.00053	47.47
ALD (HCHO):							
	IDLE (LOW)	6	.00032	.00015	.00022	.00007	29.25
	IDLE TAXI	6	.00024	.00010	.00014	.00005	34.37
	TAKE OFF	0					
	CLIMB	6	.00011	.00005	.00007	.00003	36.25
	DESCENT	6	.00012	.00007	.00009	.00002	23.31
	DESCENT ON	6	.00016	.00006	.00010	.00005	43.57
	APPROACH	6	.00008	.00004	.00006	.00001	25.23
	TAXI	6	.00012	.00007	.00010	.00002	16.94

TABLE 7.2-5

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : LYCOMING IO-360 TEST START : HOT & COLD

	MODE	NO. OF OBS	MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
			-------------	#/# FUEL	-------------		
CO:							
	IDLE (LOW)	11	1.34400	.72621	.96445	.17952	10.61
	IDLE TAXI	12	1.28200	.67780	.96814	.16531	17.07
	TAKE OFF	12	1.22294	.91303	1.06446	.09042	8.49
	CLIMB	12	1.21059	.61782	1.04160	.15437	14.82
	DESCENT	12	1.28652	.51873	1.02723	.19266	18.76
	APPROACH	12	1.37700	.71721	1.05853	.20836	19.68
	TAXI	12	1.34925	.99221	1.12646	.11664	10.35
CO2:							
	IDLE (LOW)	11	1.50713	.46057	.99766	.31493	31.57
	IDLE TAXI	12	1.97070	.64203	1.29614	.37785	29.15
	TAKE OFF	12	1.63343	1.14601	1.39451	.14298	10.25
	CLIMB	12	2.11163	1.16654	1.43197	.24536	17.13
	DESCENT	12	2.26711	1.04570	1.45348	.30689	21.11
	APPROACH	12	1.94236	.88105	1.39676	.33583	24.04
	TAXI	12	1.35352	.61602	.96006	.19558	20.37
THC :							
	IDLE (LOW)	11	.44301	.06198	.10693	.12911	69.07
	IDLE TAXI	12	.28550	.02500	.09267	.07539	81.35
	TAKE OFF	12	.02058	.01236	.01531	.00265	17.31
	CLIMB	12	.02409	.01059	.01483	.00365	24.62
	DESCENT	12	.01993	.01066	.01517	.00252	16.62
	APPROACH	12	.02300	.01410	.01750	.00337	19.25
	TAXI	12	.29139	.03874	.11971	.08163	68.19
NOX (NO2):							
	IDLE (LOW)	10	.00106	.00010	.00052	.00040	77.73
	IDLE TAXI	11	.00341	.00006	.00101	.00094	93.44
	TAKE OFF	11	.00565	.00124	.00293	.00143	48.79
	CLIMB	10	.00345	.00137	.00250	.00076	30.33
	DESCENT	11	.00775	.00093	.00311	.00206	66.24
	APPROACH	11	.00970	.00037	.00419	.00314	75.03
	TAXI	11	.00243	.00012	.00081	.00075	93.69
ALD (HCHO):							
	IDLE (LOW)	11	.00211	.00011	.00063	.00060	96.02
	IDLE TAXI	12	.00124	.00008	.00054	.00036	67.61
	TAKE OFF	0					
	CLIMB	11	.00051	.00006	.00017	.00013	73.66
	DESCENT	12	.00027	.00006	.00013	.00006	44.76
	APPROACH	12	.00037	.00005	.00013	.00009	65.61
	TAXI	12	.00133	.00013	.00045	.00041	89.79

TABLE 7.2-6

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : CONTINENTAL IO-360                                   TEST START : HOT & COLD

                                           ------------- #/# FUEL ------------

                   MODE          NO. OF      MAX         MIN       MEAN       STND       %COEF
                                  OBS       VALUE       VALUE                 DEV         VAR

          CO:
                IDLE (LOW)         8        .59379      .34654     .48505     .09158     18.88
                IDLE TAXI          8        .66059      .44943     .51667     .07299     14.13
                TAKE OFF           8       1.07268      .68889     .92280     .10928     11.84
                CLIMB              8       1.02069      .60021     .81400     .18640     22.90
                DESCENT            8       1.06604      .69003     .90198     .16954     18.80
                APPROACH           7       1.09023      .59021     .88868     .21457     24.15
                TAXI               7        .52146      .44290     .48345     .02471      5.11
         CO2:
                IDLE (LOW)         8       2.31156      .64249    1.61346     .57146     35.42
                IDLE TAXI          8       2.30569      .91972    1.73472     .46596     26.86
                TAKE OFF           8       1.95618     1.36625    1.58257     .17328     10.95
                CLIMB              8       2.12720     1.45976    1.78957     .29918     16.72
                DESCENT            8       1.99122     1.36245    1.64658     .27445     16.67
                APPROACH           7       2.13120     1.22489    1.61877     .37379     23.09
                TAXI               7       2.09564     1.05843    1.53005     .45364     29.65
  THC        :
                IDLE (LOW)         8        .50770      .05845     .22954     .142[illegible]     62.03
                IDLE TAXI          8        .43540      .03244     .17658     .13393     75.85
                TAKE OFF           8        .03653      .02007     .02602     .00473     18.18
                CLIMB              8        .01944      .01160     .01485     .00256     17.21
                DESCENT            8        .02569      .01274     .01632     .00402     24.61
                APPROACH           7        .08366      .01797     .03141     .02363     75.23
                TAXI               7        .39013      .07132     .25616     .13821     53.96
  NOx (NO2):
                IDLE (LOW)         8        .00208      .00011     .00073     .00064     87.17
                IDLE TAXI          8        .00187      .00031     .00102     .00056     55.27
                TAKE OFF           6        .01819      .00315     .00872     .00626     71.80
                CLIMB              8        .01670      .00415     .00962     .00578     60.11
                DESCENT            8        .01162      .00311     .00649     .00331     51.04
                APPROACH           7        .00815      .00159     .00457     .00218     47.63
                TAXI               7        .00135      .00034     .00086     .00047     54.55
 ALD (HCHO):
                IDLE (LOW)         8        .00083      .00015     .00054     .00022     40.85
                IDLE TAXI          7        .00069      .00028     .00047     .00013     28.87
                TAKE OFF           0
                CLIMB              8        .00027      .00007     .00019     .00007     39.66
                DESCENT            7        .00035      .00008     .00017     .00009     50.72
                APPROACH           7        .00067      .00011     .00024     .00020     83.02
                TAXI               7        .00071      .00028     .00041     .00014     34.06
```

TABLE 7.2-7

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : CONTINENTAL IO-470 TEST START : HOT & COLD

	MODE	NO. OF OBS	MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
		------------- #/# FUEL ------------					
CO:							
	IDLE (LOW)	12	.75496	.25957	.57606	.12514	21.72
	IDLE TAXI	12	.87255	.43397	.71085	.17272	24.30
	TAKE OFF	12	.96890	.63532	.78611	.12115	15.41
	CLIMB	12	.85705	.66527	.77797	.07164	9.21
	DESCENT	12	.92338	.74749	.88126	.05234	5.94
	APPROACH	12	1.04279	.89113	.94826	.04194	4.42
	TAXI	12	.94729	.48903	.80678	.13455	16.68
CO2:							
	IDLE (LOW)	12	2.10221	.62391	1.41737	.45342	31.99
	IDLE TAXI	12	2.38686	1.07986	1.72516	.44641	25.88
	TAKE OFF	12	2.05324	1.51230	1.79818	.19030	10.58
	CLIMB	12	2.03277	1.67193	1.84540	.12307	6.67
	DESCENT	12	1.90178	1.56124	1.68007	.09274	5.52
	APPROACH	12	1.67313	1.40960	1.57395	.07239	4.60
	TAXI	12	2.13066	.84700	1.34162	.41888	31.22
THC :							
	IDLE (LOW)	12	.48458	.09109	.24598	.13272	53.96
	IDLE TAXI	12	.20808	.01402	.08502	.06344	74.61
	TAKE OFF	12	.04486	.01332	.02576	.00926	35.93
	CLIMB	12	.03437	.01080	.01510	.00647	42.87
	DESCENT	12	.03234	.01198	.01604	.00577	35.99
	APPROACH	12	.02140	.01234	.01629	.00317	19.45
	TAXI	12	.28071	.01629	.15713	.07834	49.86
NOX (NO2):							
	IDLE (LOW)	10	.00089	.00000	.00031	.00030	95.64
	IDLE TAXI	11	.00137	.00009	.00068	.00041	59.88
	TAKE OFF	12	.01355	.00140	.00674	.00423	62.79
	CLIMB	12	.01171	.00104	.00579	.00297	51.24
	DESCENT	12	.00885	.00084	.00418	.00227	54.27
	APPROACH	12	.00488	.00090	.00334	.00133	39.83
	TAXI	12	.00117	.00029	.00063	.00035	55.55
ALD (HCHO):							
	IDLE (LOW)	12	.00143	.00035	.00079	.00035	44.54
	IDLE TAXI	12	.00066	.00019	.00042	.00018	43.42
	TAKE OFF	0					
	CLIMB	12	.00038	.00004	.00015	.00010	65.42
	DESCENT	12	.00026	.00005	.00013	.00007	53.80
	APPROACH	11	.00034	.00002	.00013	.00009	70.83
	TAXI	12	.00087	.00008	.00044	.00020	46.02

TABLE 7.2-8

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : CONTINENTAL IO-520 TEST START : HOT & COLD

	MODE	NO. OF OBS	-------------	-------------	#/# FUEL	-------------	-------------
			MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
CO:							
	IDLE (LOW)	9	.87525	.52054	.66112	.12490	18.89
	IDLE TAXI	9	1.00574	.51692	.76696	.17306	22.56
	TAKE OFF	9	.59591	.26555	.44276	.11096	25.06
	CLIMB	9	.98027	.33273	.63215	.24573	38.87
	DESCENT	9	.99754	.60799	.77693	.15772	20.30
	APPROACH	9	1.19085	.76612	.95066	.17687	18.60
	TAXI	9	.99381	.80523	.91836	.07127	7.76
CO2:							
	IDLE (LOW)	9	1.74266	.88155	1.37625	.35018	25.44
	IDLE TAXI	9	2.21536	1.11601	1.59955	.38485	24.06
	TAKE OFF	9	2.67452	2.14597	2.38044	.17541	7.37
	CLIMB	9	2.57073	1.54043	2.09426	.39045	18.64
	DESCENT	9	2.12797	1.51350	1.86429	.25024	13.42
	APPROACH	9	1.87979	1.19698	1.58123	.28383	17.95
	TAXI	9	1.77151	1.26065	1.44190	.20274	14.06
THC :							
	IDLE (LOW)	9	.37222	.07073	.21731	.09061	41.69
	IDLE TAXI	9	.15356	.02757	.09661	.04830	50.00
	TAKE OFF	9	.01995	.00770	.01254	.00470	37.52
	CLIMB	9	.01138	.00715	.00899	.00153	17.03
	DESCENT	9	.01118	.00803	.00975	.00106	10.88
	APPROACH	9	.01585	.01021	.01286	.00206	16.01
	TAXI	9	.09584	.02472	.07175	.02861	39.87
NOx (NO2):							
	IDLE (LOW)	7	.00037	.00014	.00027	.00007	26.80
	IDLE TAXI	8	.00097	.00029	.00060	.00025	41.92
	TAKE OFF	7	.03914	.00942	.02281	.01158	50.76
	CLIMB	8	.01544	.00205	.00609	.00464	76.23
	DESCENT	7	.00943	.00254	.00461	.00256	55.57
	APPROACH	7	.00565	.00083	.00252	.00178	70.54
	TAXI	7	.00136	.00058	.00082	.00029	35.42
ALD (HCHO):							
	IDLE (LOW)	9	.00069	.00019	.00036	.00016	44.66
	IDLE TAXI	9	.00054	.00006	.00024	.00016	65.14
	TAKE OFF	0					
	CLIMB	9	.00031	.00006	.00014	.00009	64.23
	DESCENT	9	.00035	.00005	.00017	.00009	54.23
	APPROACH	9	.00065	.00004	.00025	.00025	100.27
	TAXI	8	.00075	.00002	.00028	.00024	85.61

TABLE 7.2-9

SCOTT RESEARCH LABORATORIES   SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA - PISTON ENGINES

ENGINE : LYCOMING IO-540   TEST START : HOT & COLD

	MODE	NO. OF OBS	#/# FUEL MAX VALUE	#/# FUEL MIN VALUE	#/# FUEL MEAN	#/# FUEL STND DEV	#/# FUEL %COEF VAR
CO:							
	IDLE (LOW)	12	1.06791	.69538	.87589	.12302	14.05
	IDLE TAXI	12	1.06525	.75105	.91143	.10735	11.78
	TAKE OFF	12	1.38476	1.12871	1.24358	.09134	7.34
	CLIMB	12	1.37354	1.10604	1.22126	.09368	7.67
	DESCENT	11	1.36114	1.11231	1.19496	.08452	7.07
	APPROACH	12	1.35880	1.00901	1.17338	.11779	10.04
	TAXI	12	1.30765	.91174	1.05218	.10522	10.00
CO2:							
	IDLE (LOW)	12	1.32767	.71327	.89936	.18772	20.87
	IDLE TAXI	12	1.80545	.94455	1.28072	.27914	21.80
	TAKE OFF	12	1.30295	.87348	1.10988	.15147	13.65
	CLIMB	12	1.33427	.88511	1.14484	.15615	13.64
	DESCENT	11	1.32410	.90311	1.18801	.14036	11.81
	APPROACH	12	1.48291	.88969	1.21241	.19759	16.30
	TAXI	12	1.32852	.73147	.93651	.19112	20.41
THC :							
	IDLE (LOW)	12	.39054	.10635	.26049	.08818	33.85
	IDLE TAXI	12	.24430	.02047	.12505	.06967	55.71
	TAKE OFF	12	.02181	.01191	.01632	.00292	17.87
	CLIMB	12	.02266	.01229	.01633	.00344	21.08
	DESCENT	11	.02312	.01264	.01575	.00326	20.69
	APPROACH	12	.02841	.01400	.01870	.00505	27.00
	TAXI	12	.26803	.03692	.16317	.07202	44.14
NOX (NO2):							
	IDLE (LOW)	11	.00066	.00009	.00032	.00018	55.16
	IDLE TAXI	11	.00130	.00029	.00078	.00034	43.23
	TAKE OFF	11	.00227	.00013	.00089	.00063	69.90
	CLIMB	11	.00127	.00014	.00070	.00043	60.79
	DESCENT	10	.00120	.00016	.00079	.00042	52.30
	APPROACH	11	.00185	.00017	[illegible]	.00057	66.89
	TAXI	10	.00138	.00013	.00054	.00044	80.96
ALD (HCHO):							
	IDLE (LOW)	12	.00097	.00010	.00056	.00027	48.82
	IDLE TAXI	12	.00082	.00006	.00047	.00027	57.22
	TAKE OFF	0					
	CLIMB	12	.00030	.00008	.00016	.00007	44.70
	DESCENT	11	.00023	.00007	.00011	.00005	45.42
	APPROACH	12	.00017	.00006	.00010	.00004	39.27
	TAXI	12	.00053	.00010	.00032	.00013	39.88

the mean, maximum and minimum emission rates are given for each of the five pollutants at each of the eight steady-state operating modes. The standard deviations and coefficients of variation are also included. In order to facilitate comparisons, the mass emissions rates are plotted against operating mode in Figures 7.2-1 through 7.2-8. The mean is represented by a large dot and the one-sigma limits are indicated by horizontal bars. Data for the Continental 0-470 engine were not plotted since representative data were available from only one engine.

The substantial variation in emissions from engine-to-engine of the same model is quite apparent. In general hydrocarbons and aldehydes showed the greatest variation at the low power modes while nitrogen oxides varied most at high power modes. Carbon monoxide showed less variation than hydrocarbons or nitrogen oxides, but it still had an average coefficient of variation of 16%.

7.2.2 Carbureted Engines Versus Injected Engines

In order to study the difference in emissions between engines with the two basic induction systems in popular use, carburetors and fuel injection, all piston engine emission results were grouped by engine induction system. Means and standard deviations were calculated for each mode. Outliers were named and rejected. The results are plotted in Figure 7.2-9. The means and one-sigma limits are denoted by dots and bars respectively. C and I stand for carbureted and injected.

The emissions from the two engine types differed most in the greater amount of hydrocarbons and aldehydes emitted by injected engines during low power modes. Hydrocarbon mass emissions from injected engines

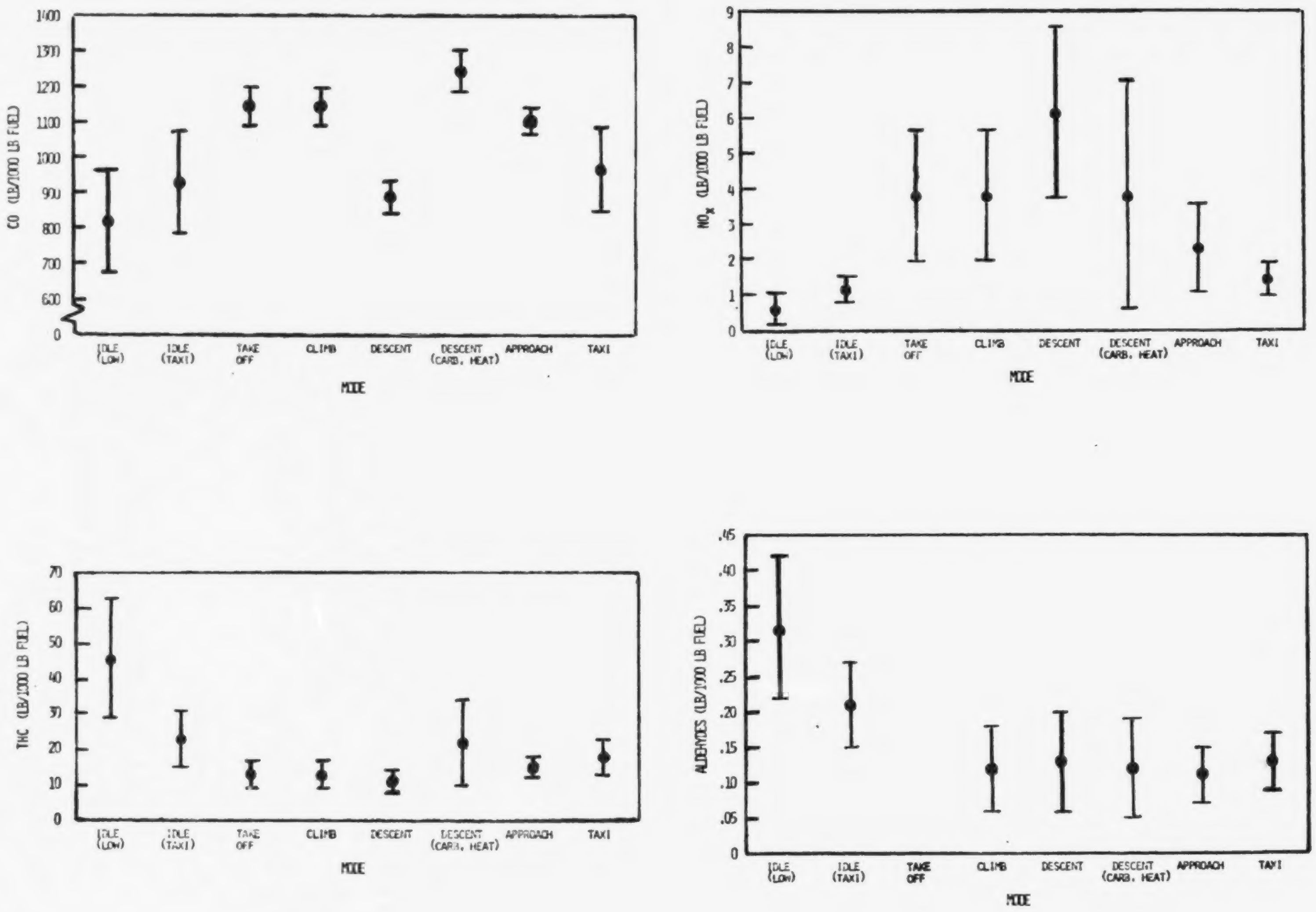


FIGURE 7.2-1 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Continental 0-200

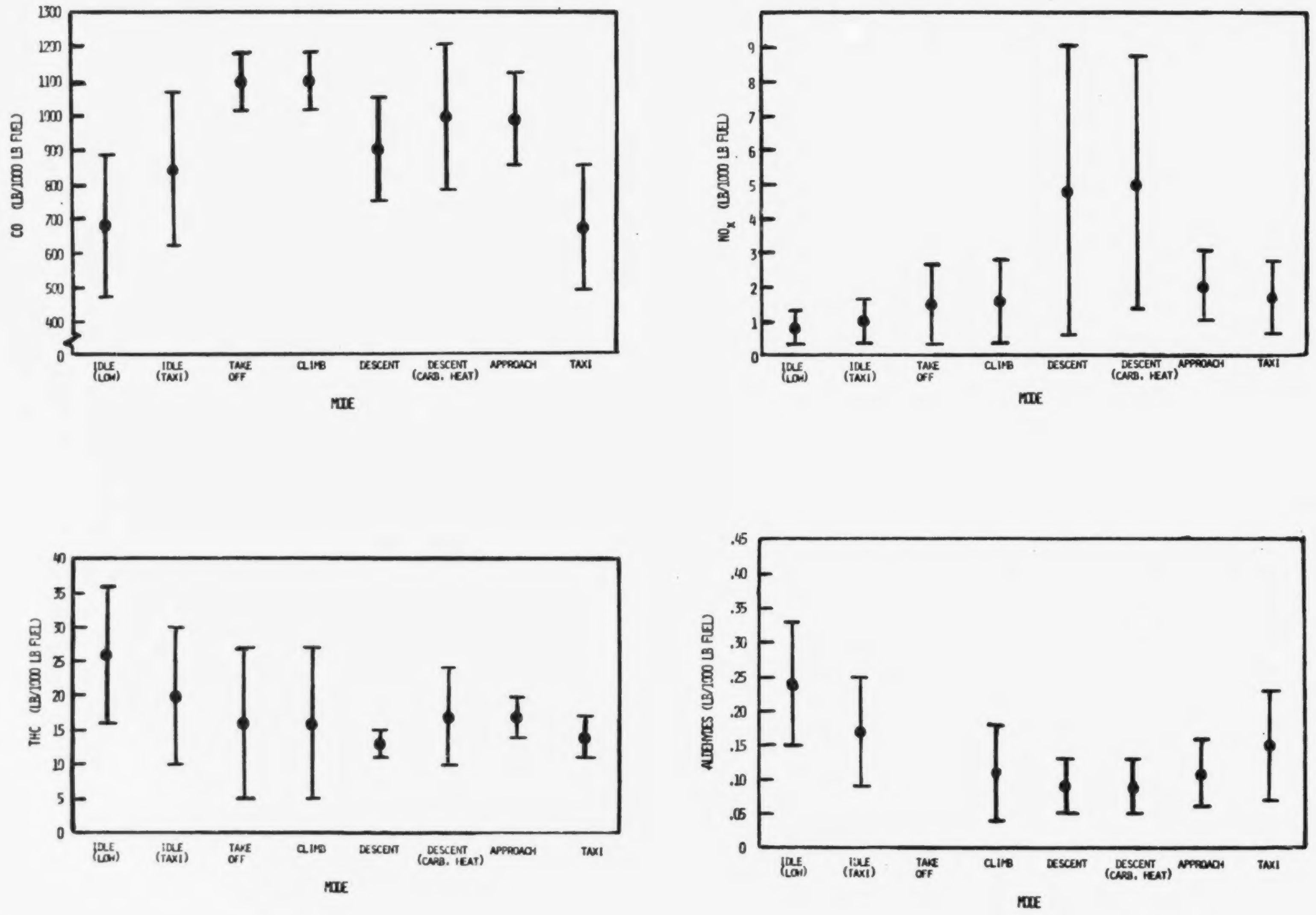


FIGURE 7.2-2 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Lycoming 0-320

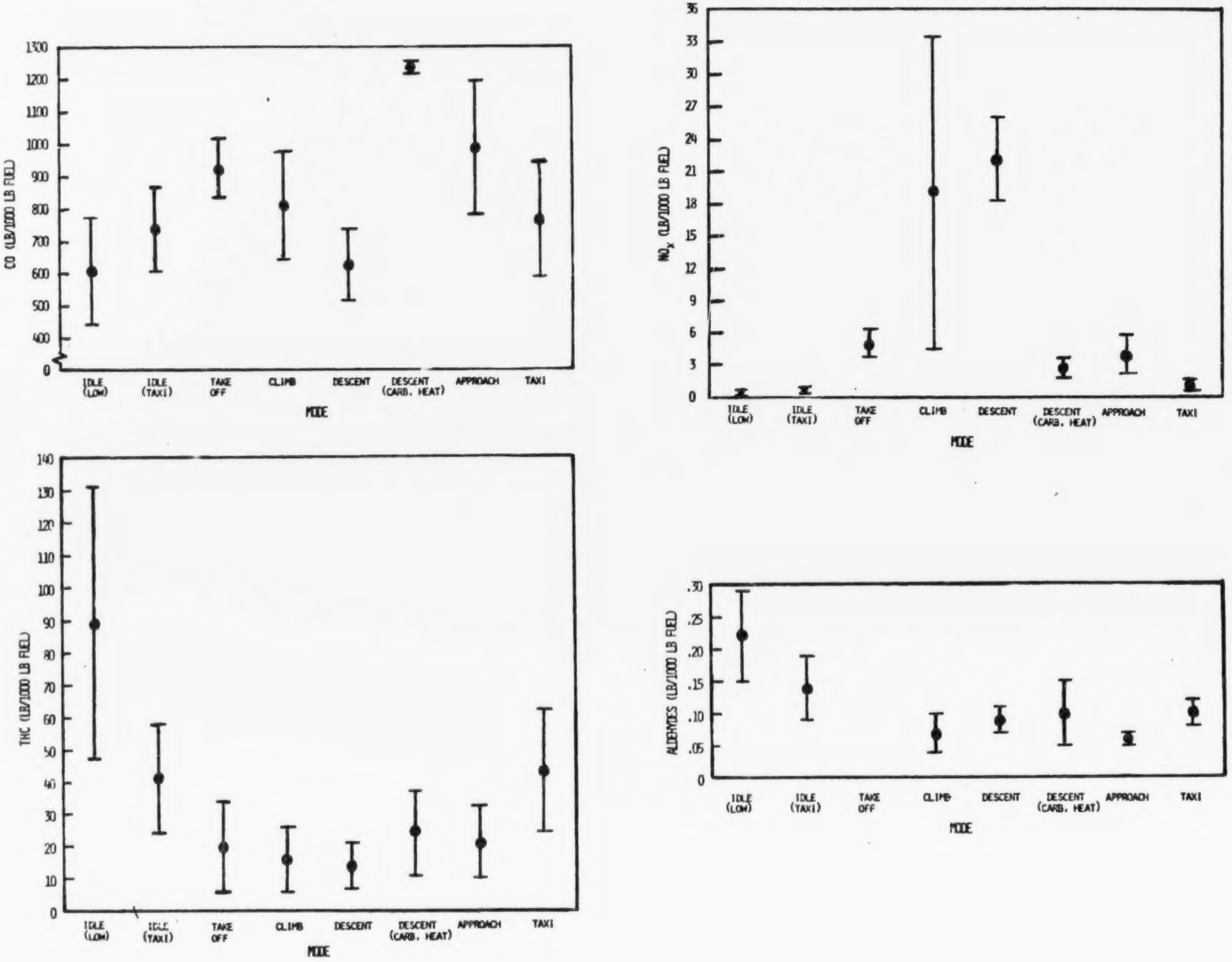


FIGURE 7.2-3 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Lycoming 0-540

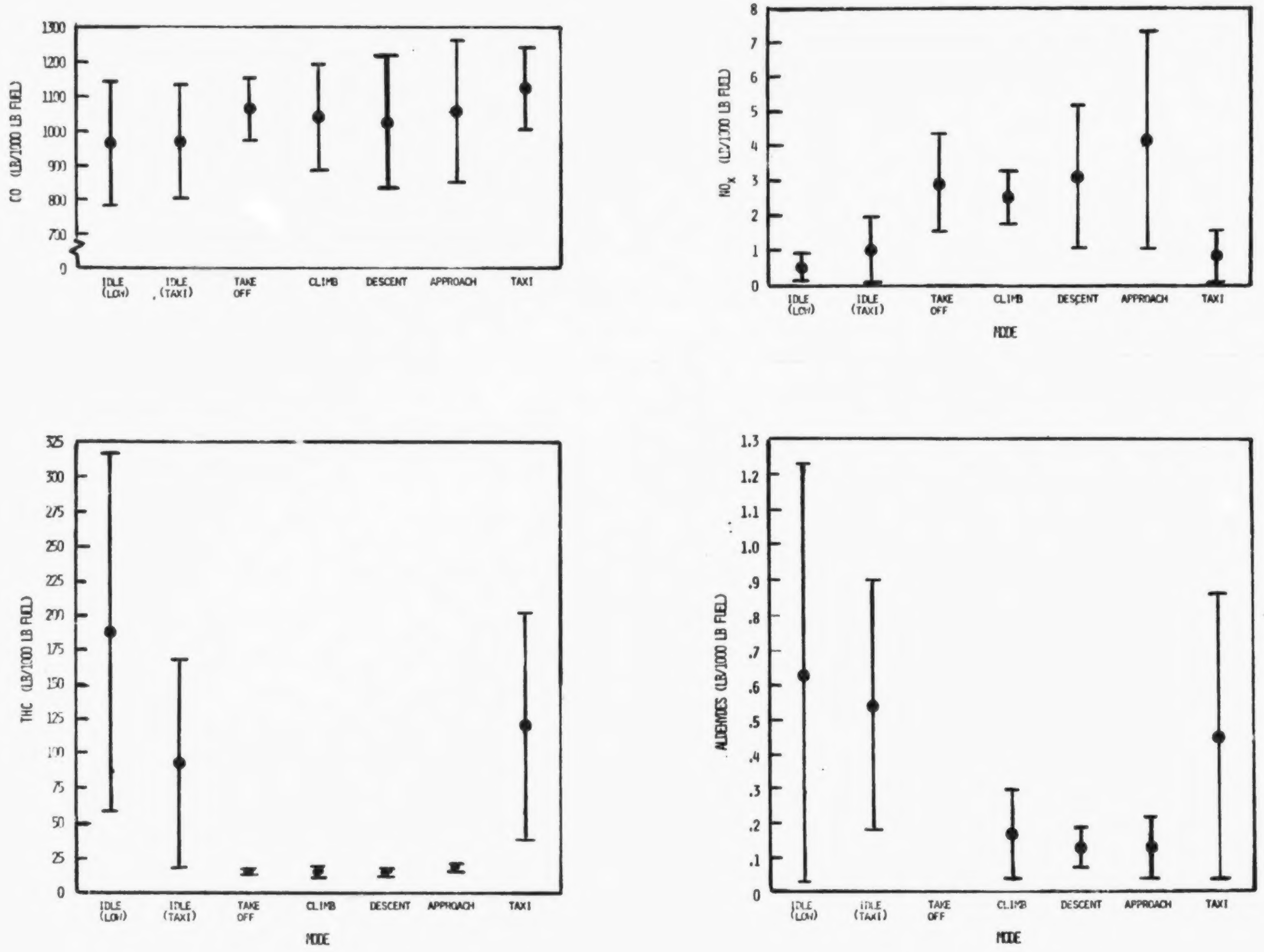


FIGURE 7.2-4 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Lycoming IO-360

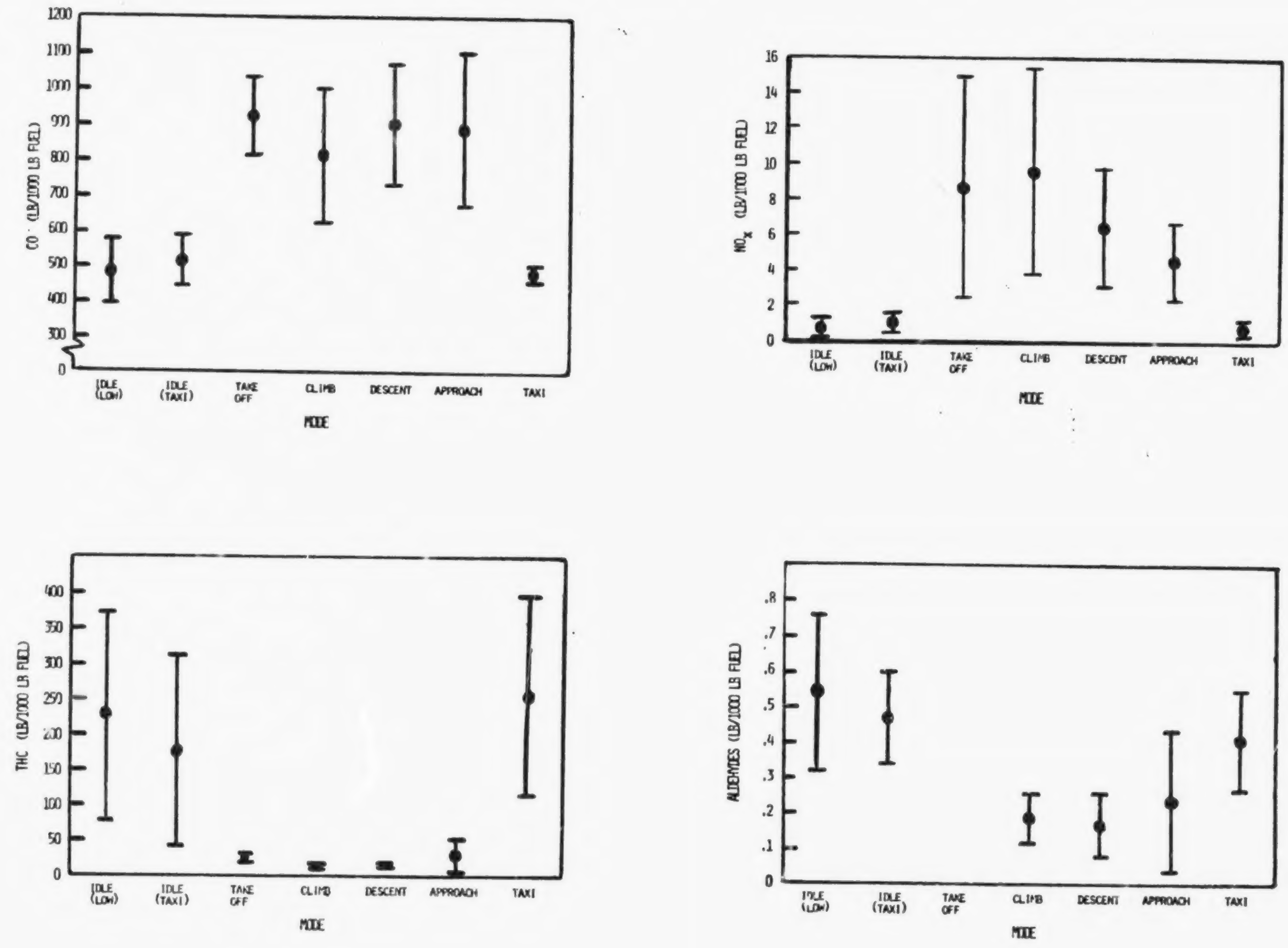


FIGURE 7.2-5 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Continental IO-360

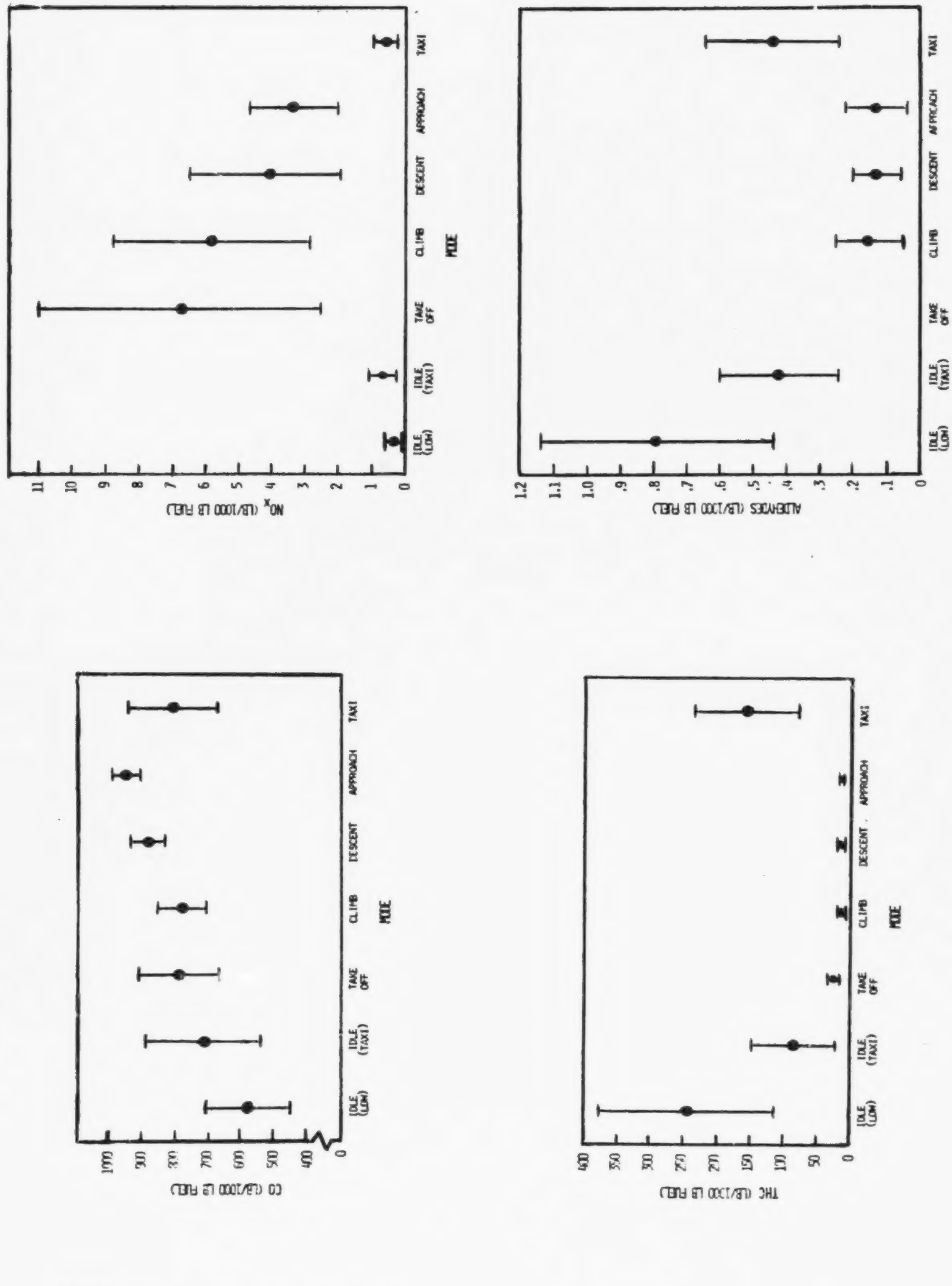


FIGURE 7.2-6 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Continental IO-470

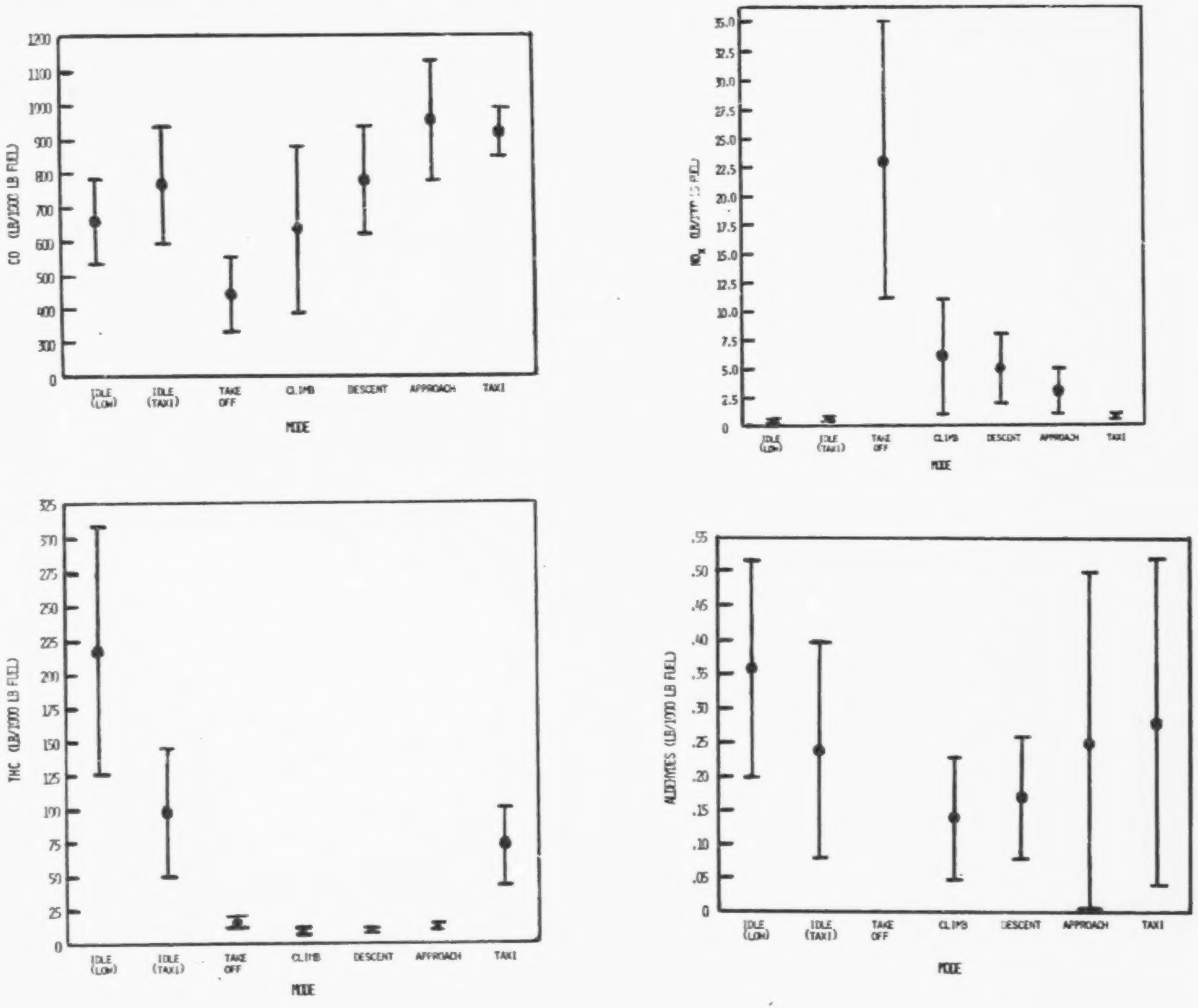


FIGURE 7.2-7 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Continental IO-520

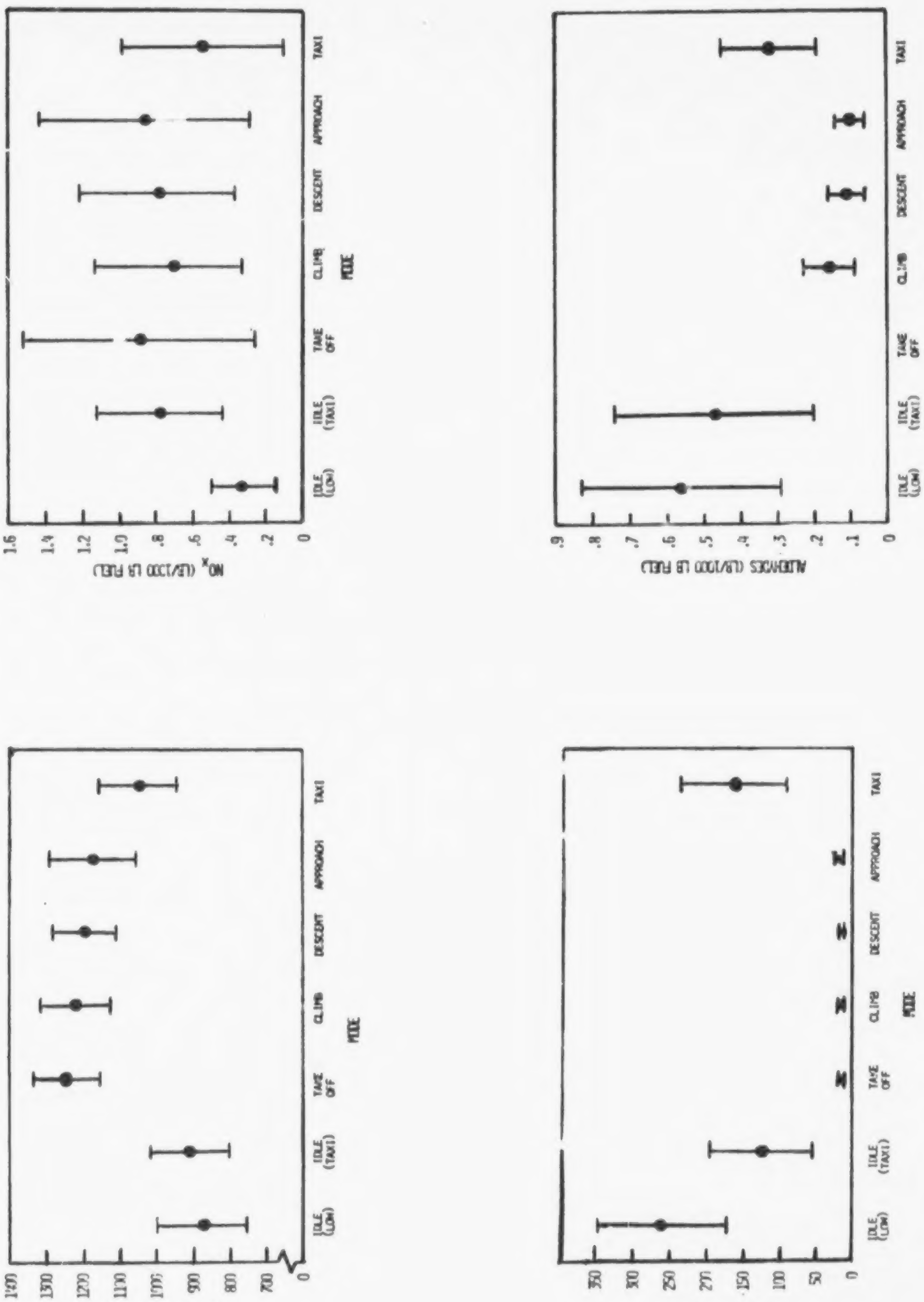


FIGURE 7.2-8 ENGINE-TO-ENGINE VARIATIONS IN EMISSIONS VS. POWER SETTING

Engine: Lycoming IO-540

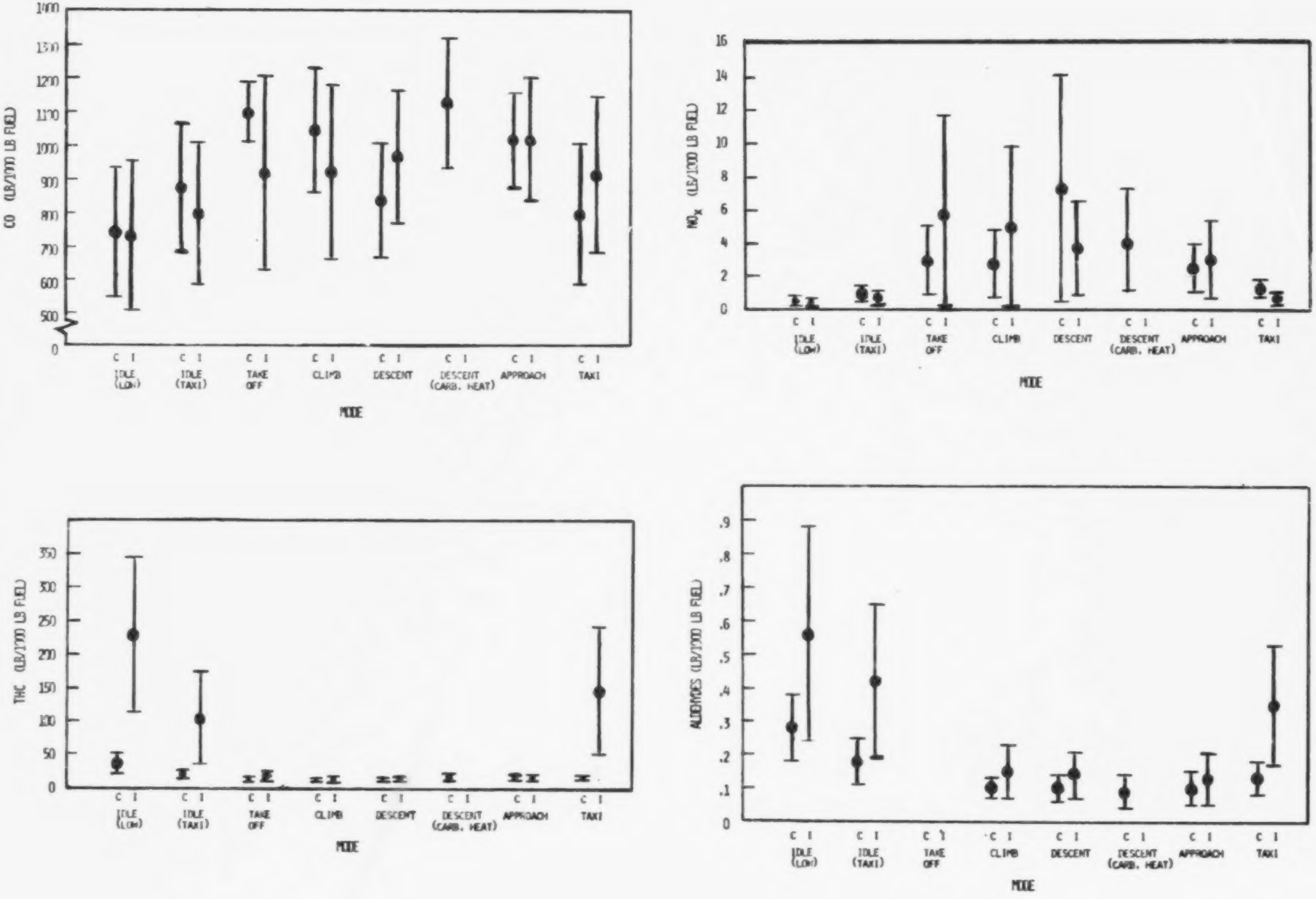


FIGURE 7.2-9 A COMPARISON OF THE EMISSIONS FROM CARBURETED AND FUEL INJECTED ENGINES

were five to ten times as great as carbureted engines at low power while aldehydes from injected engines were two to three times those from carbureted engines. Injected engines produced about twice as much NO_x as carbureted engines at take-off and climb settings, but only half as much during descent. On the other hand, CO emissions were lower from injected engines than carbureted engines at take-off and climb but greater at descent.

7.2.3 Effect of Engine Power Setting on Mass Emission Rates

The effects of engine power setting on mass emission rates for the various pollutants can be noted from Figures 7.2-1 through 7.2-8. Hydrocarbons were highest at the low power modes of low idle and taxi. This was especially true for fuel injected engines. Aldehydes followed the same pattern as hydrocarbons. Nitrogen oxides were highest at the high power modes of take off, climb, descent and approach. Carbon monoxide emission rates were usually higher at the high power modes than the low power modes, but this was not true for all engine models tested.

7.2.4 Start-up Emissions

The emissions of an aircraft engine during start-up are dependent on air temperature and engine temperature. These effects were investigated by performing both cold and hot start emissions tests on the test aircraft. A cold start was defined as one in which the engine had not been run for an extended period, generally overnight, and thus the engine temperature was equal to the ambient air temperature.

On the other hand, hot starts were usually performed within an hour of previous operation so that the engine temperature was still well above ambient air temperature.

During a cold start, the procedure was to let the engine warm up for three minutes before beginning formal exhaust gas measurements. After a hot start, formal measurements began as soon as the operator was satisfied that the engine had sufficient oil pressure and was running in a stable manner. This usually took about thirty seconds. In all cases the engine throttle was adjusted so that the engine ran at 1000 rpm as soon after starting as possible.

The amount of time it takes for an engine to reach "warmed-up" status is heavily dependent on the air temperature. During cold weather operation, it may take several minutes before an engine is considered warmed up sufficiently for take off after a cold start. During warm weather operation, the time required from a cold start may be only one minute. The manufacturers suggest that an engine be considered warmed up when it responds smoothly to throttle changes. Though the tests described in this report were made in warm weather, differences between cold starts and hot starts were noted.

During the rich conditions of start-up and engine stabilization at idle power settings, more hydrocarbons and CO were emitted than were normally emitted during idle operation after the engine was warmed up. Examination of the continuous records yields the following observations of the exhaust composition and variation during the start and warm-up.

Cold Start - Carburetor Engines

Carburetor engines were primed before a cold start. Before the engine was cranked, hydrocarbons could sometimes be detected at the exhaust pipe. However, even though the concentration was appreciable, there was no exhaust flow. When the engine started, hydrocarbon concentrations immediately increased to percent levels. Equilibrium levels were reached in about one minute during a warm weather cold start. Similarly, carbon monoxide took about one minute to reach the equilibrium value. The initial overshoot was much less than for the hydrocarbons. Nitric oxide concentrations climbed slowly due to the rich conditions and low temperatures, reaching an equilibrium value at about the same time as the carbon monoxide and hydrocarbons.

Hot Start - Carburetor Engines

The engine need not be primed with fuel when warm and no prime was used on hot starts during the program. Carbon monoxide and carbon dioxide traces reached equilibrium values in less than five seconds. Nitric oxide values did not rise as quickly but reached equilibrium values in about ten seconds. During start-up hydrocarbons reached values one and a half times equilibrium values. Equilibrium levels were reached in about ten seconds.

Cold Start - Injected Engines

Injected engines were primed for a cold start usually be running the fuel boost pump, an auxiliary electric fuel pump, while opening and closing the throttle and simultaneously cranking the engine with the electric starter. Sufficient fuel for starting was thus admitted to the cylinders. As with the carburetor engines, hydrocarbon emissions peaked at high levels during the start and then dropped smoothly to equilibrium levels which were reached in about thirty seconds during a warm weather cold start. However, in some cases, equilibrium levels were not reached until the end of the three minute warm-up period with one-half of the decrease during the last two minutes. Nitric oxide quite often spiked at the start possibly due to individual lean cylinders, but reached equilibrium in about thirty seconds. Carbon monoxide equilibrium was noted in ten to fifteen seconds and was reached by a smooth transition.

Hot Start - Injection Engine

Hot starts with an injection engine can be difficult. The engine does not always catch immediately but may make several false starts. The capabilities of the operator and his familiarity with the particular engine have a large influence on hot start emissions from an injected engine. Once the engine caught, a small nitric oxide spike was noted, and its concentration reached equilibrium in about fifteen seconds. Carbon monoxide increased to equilibrium smoothly in ten to fifteen seconds. After the initial spike, hydrocarbons stabilized in fifteen to thirty seconds.

Emission Levels During Start Up

Hydrocarbon emissions are noticeably high during start-up. The level of hydrocarbon emissions relative to the hydrocarbon emission during stabilized idle was determined for the first minute of engine operation during both hot starts and cold starts. The data obtained with Continental O-200, Continental IO-470 and Lycoming IO-540 engines was examined by dividing the first minute of continuous hydrocarbon analog record into tenth minute intervals beginning at the instant of engine start. Hydrocarbon concentrations were read at each tenth minute interval. Injected engines and carburetor engines were treated separately in both hot starts and cold starts. Ratios of average values of hydrocarbon emission to stabilized idle levels are plotted against time in Figure 7.2-10 for both carbureted and injected engines.

Although continuous recordings of start-up emissions were made, due to the extremely high levels of hydrocarbon concentrations during start, the hydrocarbon instrument was not always attenuated sufficiently to keep the reading from going off scale. The problem is further compounded by the variability of hydrocarbon level from engine-to-engine and from run to run. The values presented in Figure 7.2-10 therefore should be considered as representative of the gross level encountered and not as definitive values.

Injected engines produced more hydrocarbons during start-up than carbureted engines with levels one minute after start averaging three times the level at stabilized idle for a cold start and one and a half times the stabilized idle level for hot starts. Cold starts for both engine types are characterized by sharp rises to levels ten or more times stabilized idle levels during the first half minute of operation.

7.2.5 Emissions Resulting From A Hot Start Or A Cold Start

Cold start tests were those tests in which the engine had not been run for several hours, usually overnight. After start, the engine was run at 1000 rpm for three minutes, after which time emission measurements were begun at the first steady test mode, Low Idle. In hot start tests the engines had been run within an hour of being tested. Emission measurements on hot start engines were begun as soon as the engine had stabilized which usually took less than thirty seconds.

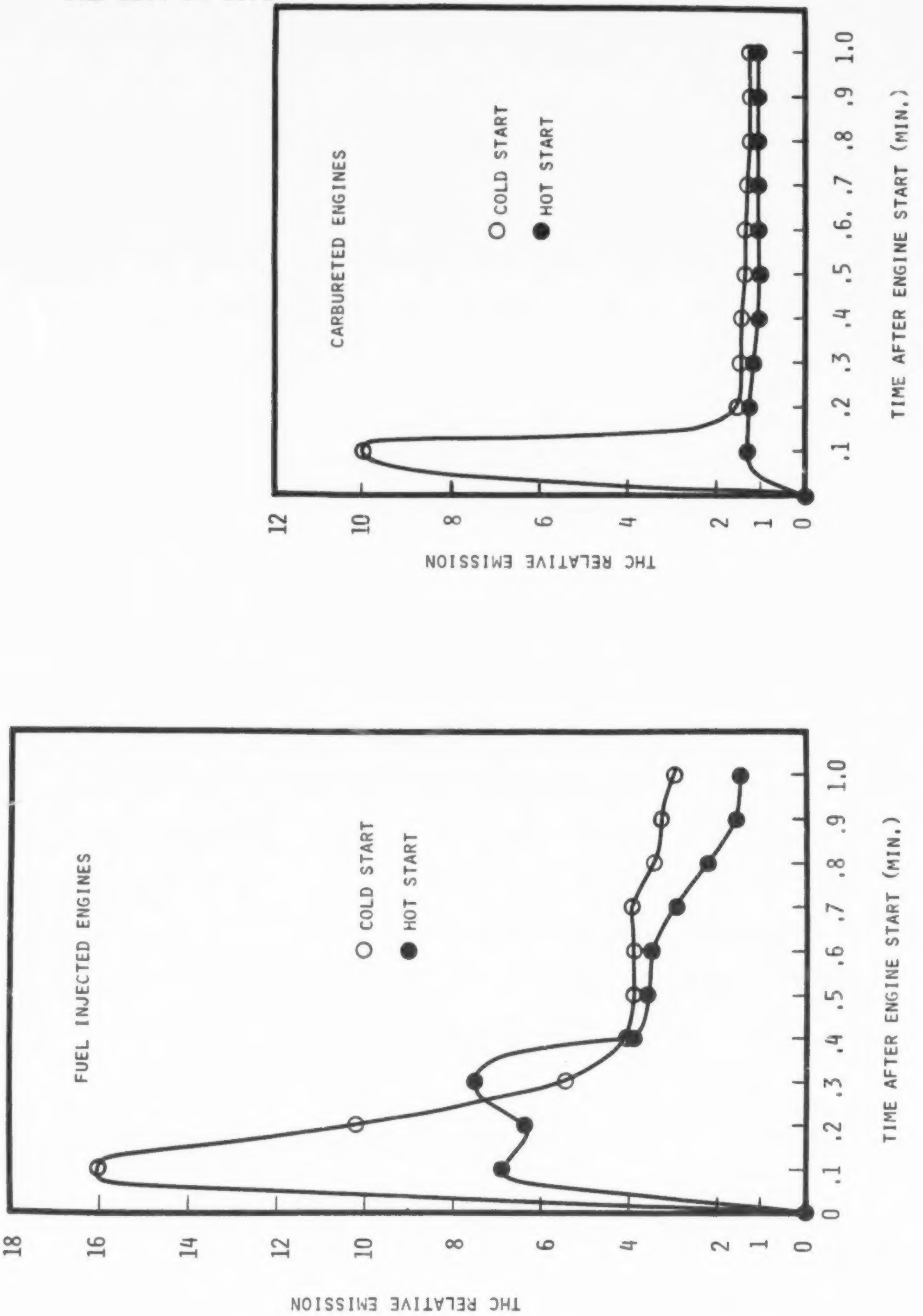


FIGURE 7.2-10 HYDROCARBON START-UP EMISSIONS
RELATIVE TO EMISSION AT STABILIZED IDLE

This definition of hot start and cold start is consistent with daily practice. Engines which stand overnight are generally warmed up before taxiing to the end of the runway. While the engine is warming up, the pilot usually performs a radio check and instrument check. An aircraft engine is more likely to be warmed up while standing at a controlled airport where the pilot must wait for radio clearance from the tower before he can taxi to the runway. When beginning a flight with an aircraft with a warm engine, the tendency is to start taxiing as soon as the engine runs smoothly. At uncontrolled airports, an aircraft with a warm engine is taxied almost immediately.

A comparison of the differences in emissions after a hot or cold starts for each engine model was performed by plotting the mean and one-sigma limits on a mode basis for each pollutant measured. One carbureted engine and one injected engine were selected for illustration. These were characterized by four graphs, one for each pollutant, which are presented in Figures 7.2-11 and 7.2-12.

In evaluating the results it must be noted that in the cold start tests the engines were actually hotter in the first two test modes (low idle and taxi) than in the hot start tests because of the three-minute warm-up at 1000 rpm. Thus, the cold start tests showed emissions characteristic of richer air-fuel mixtures as compared to the hot starts. In other words, the higher temperatures during the low idle and taxi modes of the cold start resulted in less weight of air being drawn in, with resulting richer cylinder mixtures. After a few seconds at high power, the temperatures of cold and hot starts were essentially the same and emission rates were also similar.

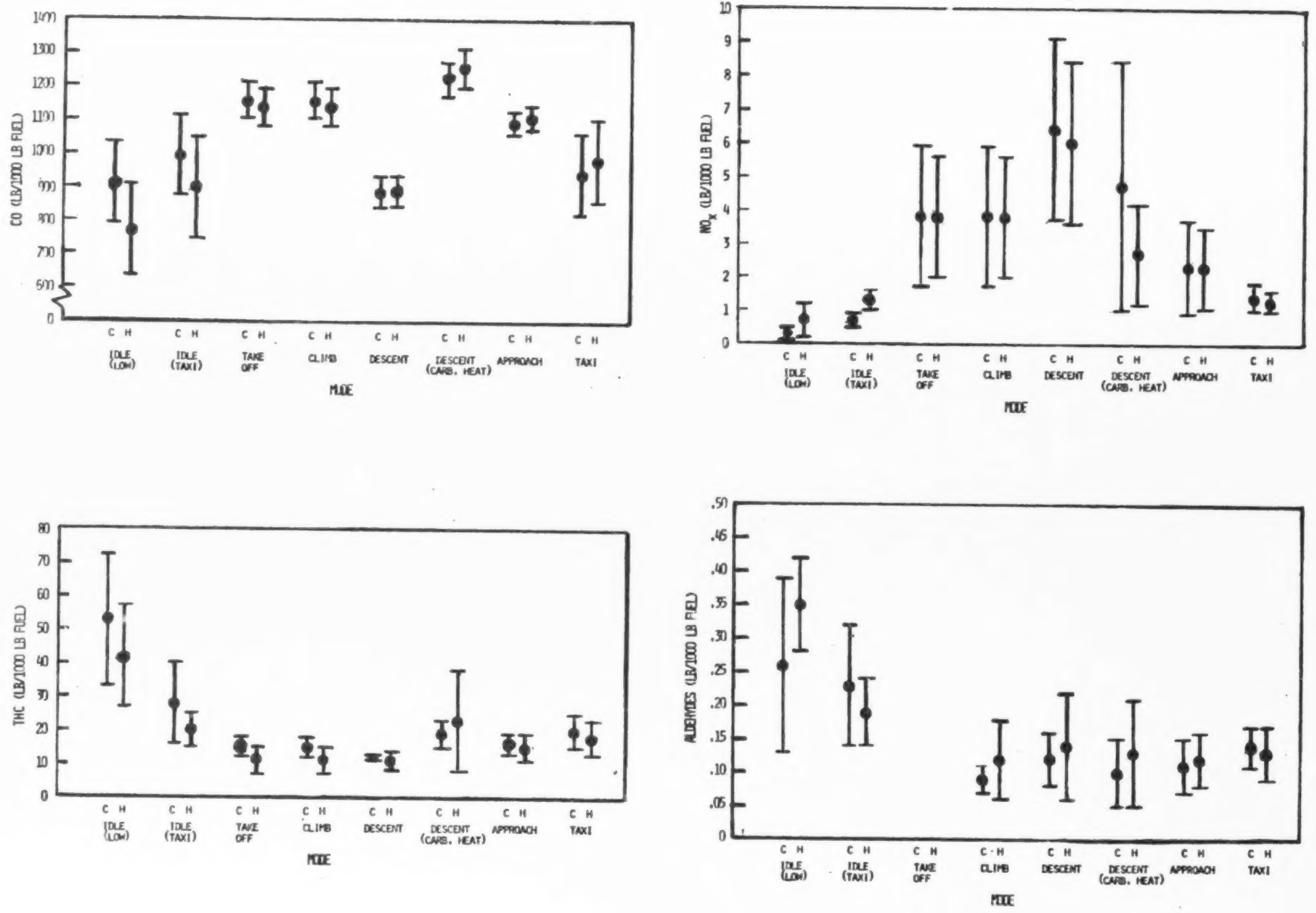


FIGURE 7.2-11 EFFECT OF COLD START VS. HOT START ON A CARBURETED ENGINE

Engine: Continental 0-200

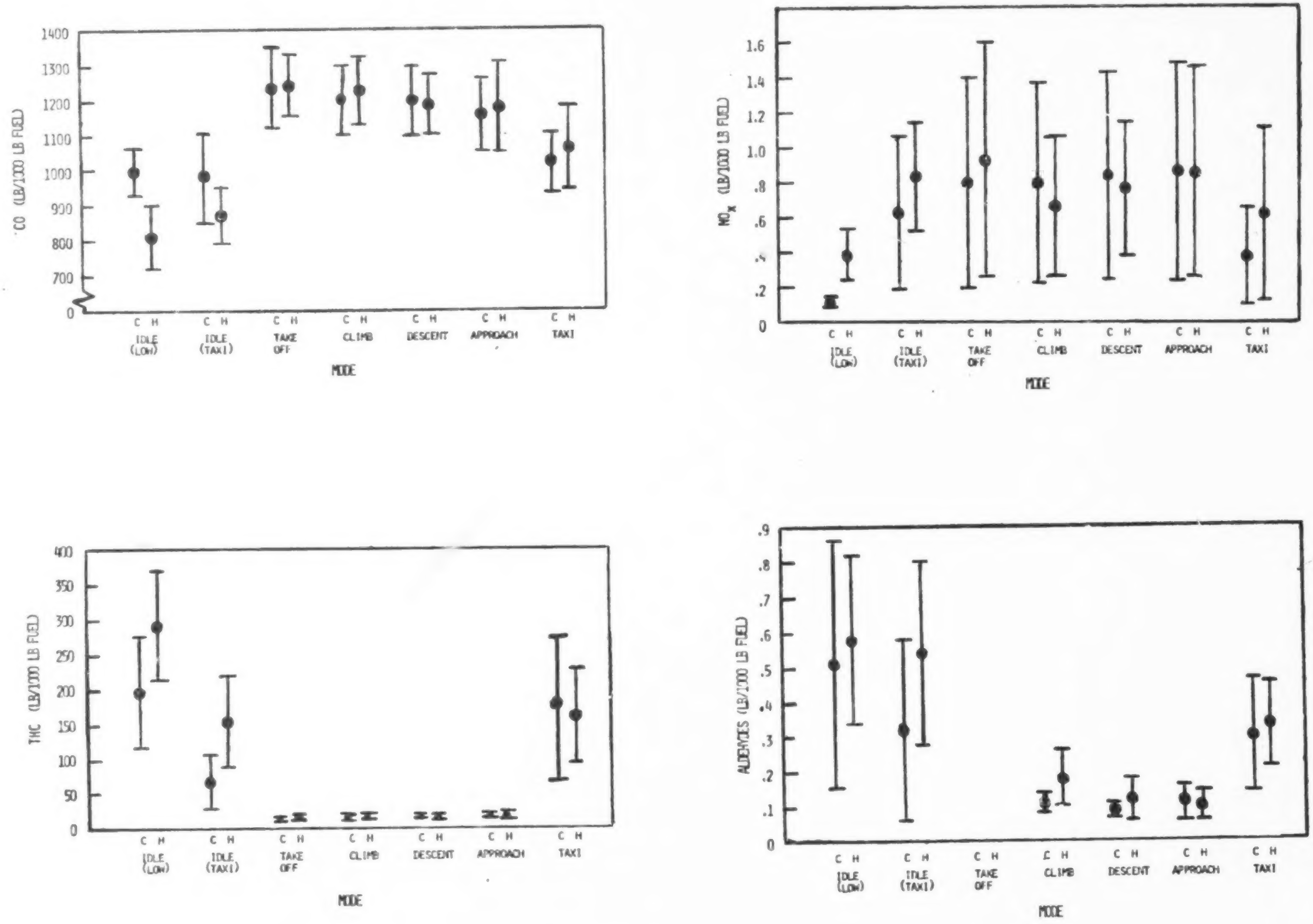


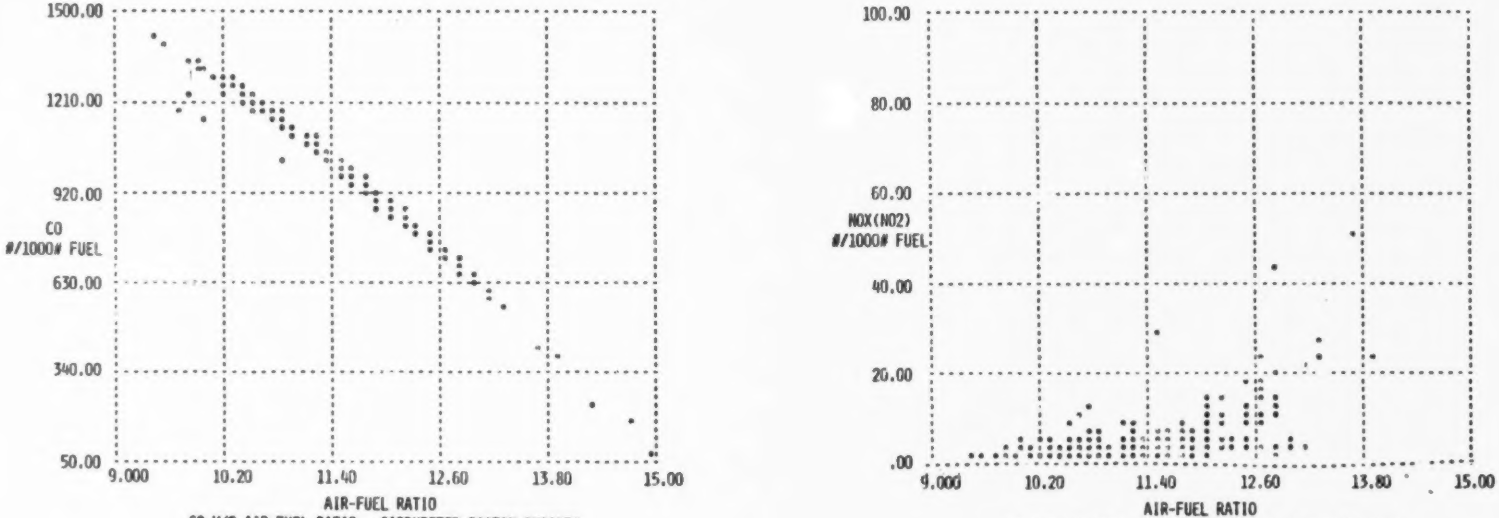
FIGURE 7.2- 12 EFFECT OF COLD START VS. HOT START ON A FUEL INJECTED ENGINE

Engine: Lycoming IO-540

The data for the Continental 0-200 and the Lycoming IO-540 engines shown in Figures 7.2-11 and 7.2-12 support the above statements. For both engines, carbon monoxide was higher and nitric oxide was lower during low idle and idle-taxi for cold starts than for hot starts. The differences at take-off and subsequent test modes are essentially negligible. Hydrocarbons and aldehydes also showed differences primarily at low idle and idle taxi, but the differences were not consistent. The 0-200 had higher hydrocarbon emissions during cold start tests, while the IO-540 emitted higher hydrocarbons during hot starts. An examination of data for the other engines tested showed that all carburetor engines emitted higher hydrocarbons during cold starts than hot starts, but the injected engines showed no consistent differences between hot and cold starts. Aldehydes tended to follow the hydrocarbon pattern. Data analysis was further complicated by the fact that some engines had dual exhausts with hot starts performed on each exhaust, but cold starts on only one. Significant differences between the compositions of the two exhausts were found for some engines.

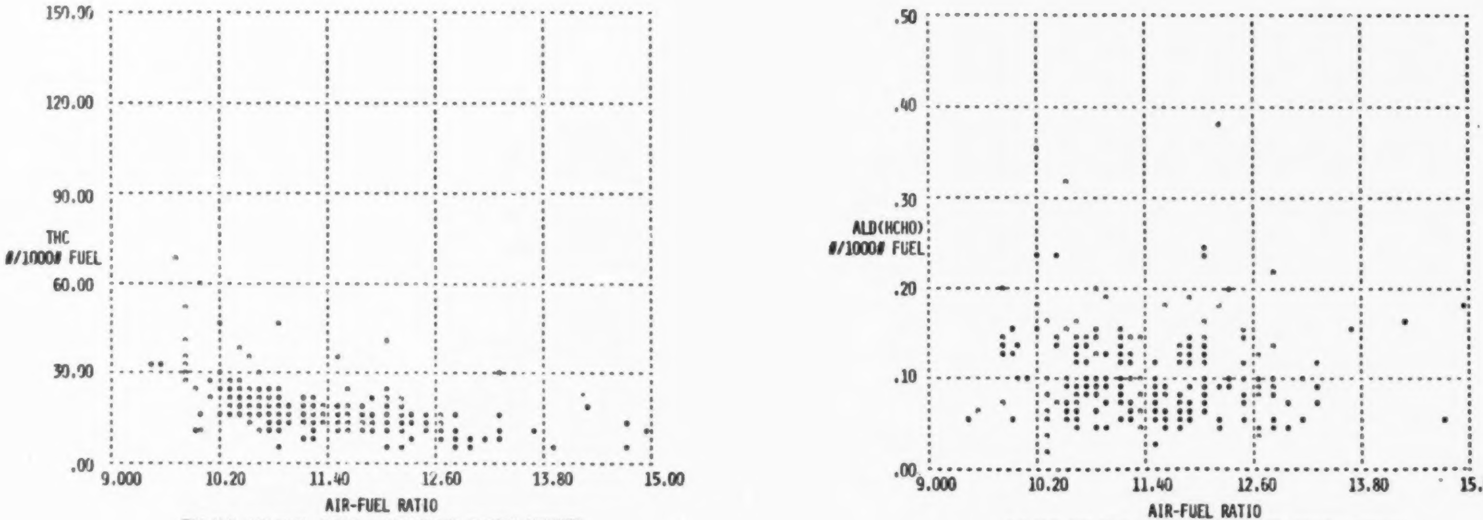
7.2.6 Effect Of Air/Fuel Ratio On Emission Rates

Computer plots of pollutant exhaust emission rate versus air/fuel ratio were made by lumping all carbureted engines together and all injected engines together. These plots are presented in Figures 7.2-13 and 7.2-14. The three low power modes and the run-up modes were not used in these plots. The air/fuel ratio calculation formulas used did not have a correction factor for hydrocarbons when the hydrocarbons exceeded 1% (10,000 ppm). This resulted in questionable calculated air/fuel ratios at low power modes where hydrocarbons frequently exceeded 1%. Run-up modes were omitted because they are transient conditions.



CO V/S AIR-FUEL RATIO - CARBURETED PISTON ENGINES

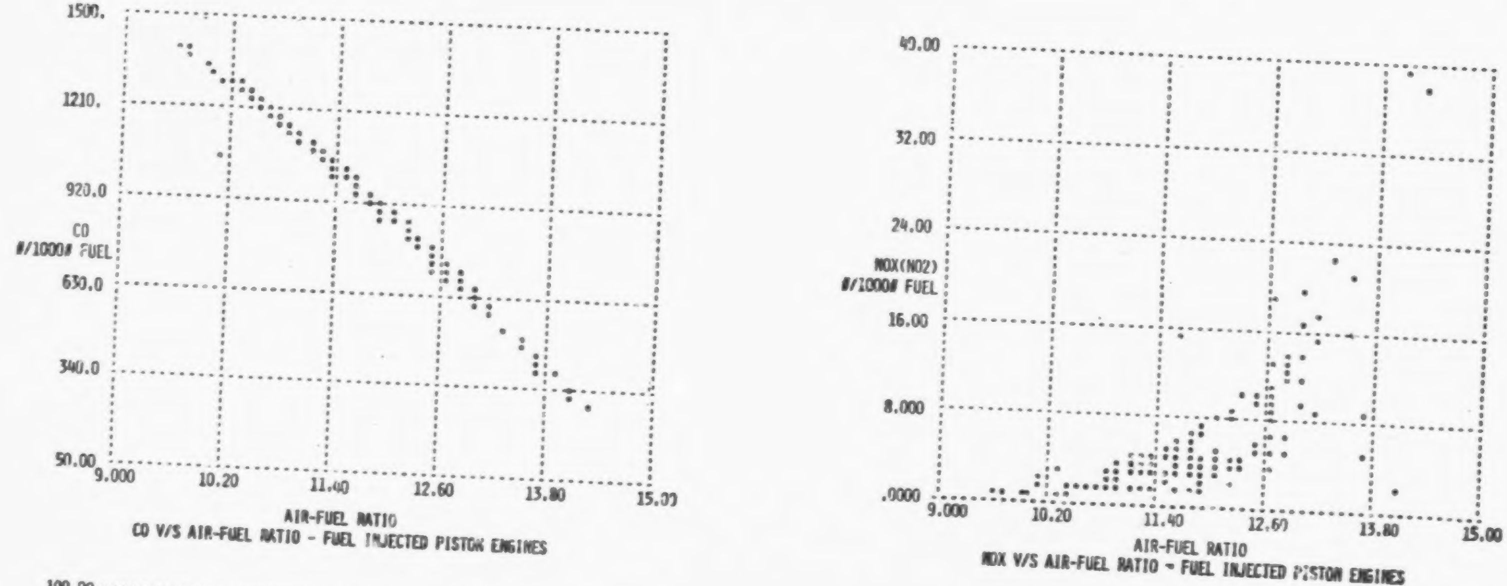
NOX V/S AIR-FUEL RATIO - CARBURETED PISTON ENGINES



THC V/S AIR-FUEL RATIO - CARBURETED PISTON ENGINES

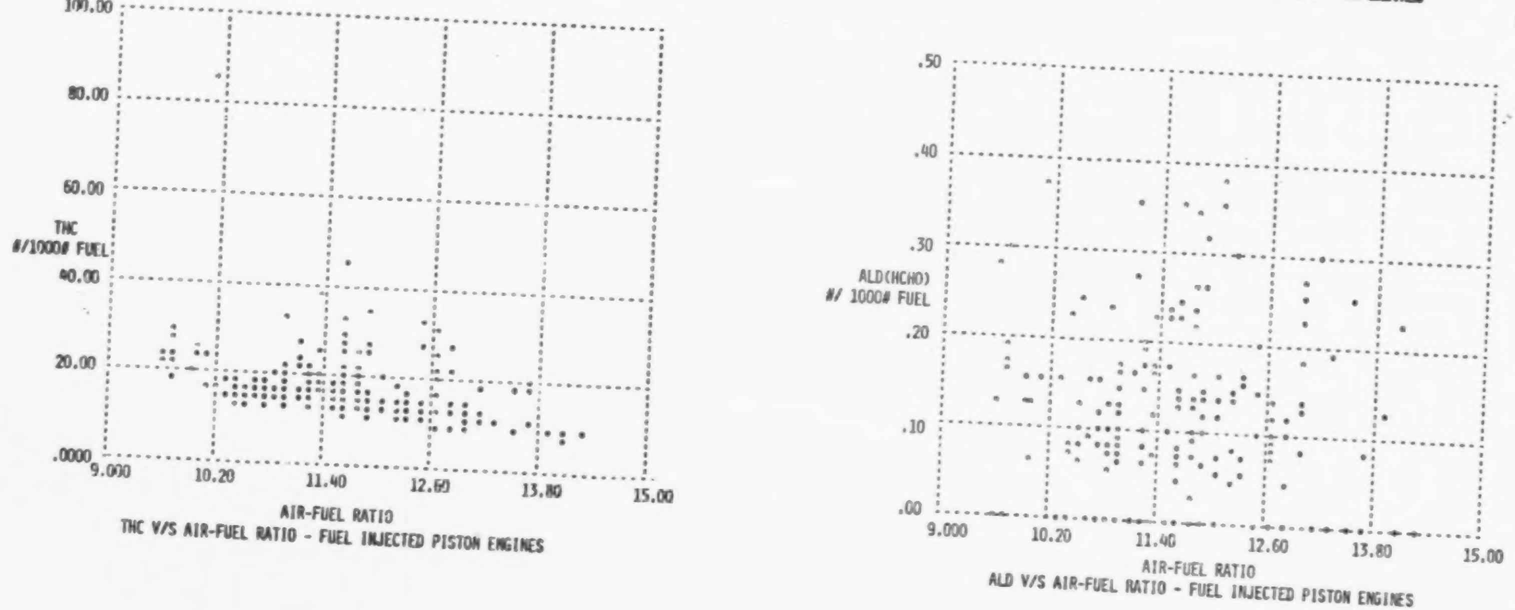
ALD V/S AIR-FUEL RATIO - CARBURETED PISTON ENGINES

FIGURE 7.2-13 EMISSIONS VS AIR-FUEL RATIO - CARBURETED ENGINES



CO V/S AIR-FUEL RATIO - FUEL INJECTED PISTON ENGINES

NOX V/S AIR-FUEL RATIO - FUEL INJECTED PISTON ENGINES



THC V/S AIR-FUEL RATIO - FUEL INJECTED PISTON ENGINES

ALD V/S AIR-FUEL RATIO - FUEL INJECTED PISTON ENGINES

FIGURE 7.2-14 EMISSIONS VS AIR-FUEL RATIO - FUEL INJECTED ENGINES

For the conditions shown in Figures 7.2-13 and 7.2-14, carbon monoxide exhibited a very strong dependence on air/fuel ratio, decreasing with increasing air/fuel ratio. Hydrocarbons showed a slight tendency for increase with decreasing air/fuel ratio, but the magnitude of change was small. Nitric oxide is seen to increase with increasing air/fuel ratio, with a very rapid increase occurring when the air/fuel ratio increased above 12. Aldehydes showed no apparent relationship to air/fuel ratio.

7.2.7 Contribution of Various Engine and Ambient Parameters to Variation in Exhaust Emissions

Multiple linear regression analyses were performed on the mass emissions data of the nine piston aircraft engine models studied in order to assess the contribution of various engine and ambient parameters to the variation in exhaust emissions. The aircraft engines were grouped into carbureted and fuel injected engines and studied separately. This grouping was necessary because it had been noted from data plots that carbureted and injected engines constituted two different sets of population, although there was a certain degree of overlap in some of the high power modes.

The basic regression matrix was comprised of one of the pollutants (carbon monoxide, total hydrocarbons, nitrogen oxides or aldehydes) as the dependent variable and the following as the independent variables: air/fuel ratio, exhaust gas temperature (EGT), brake horsepower (BHP), brake specific fuel consumption (BSFC), and absolute humidity (HUM). The BSFC is a specific measure of the load conditions in each mode and was calculated as the fuel flow divided by the brake horsepower. Since the horsepower in each mode for each engine was not measured, it was estimated from manufacturers' performance curves.

The general approach employed in developing the analyses was to regress the independent variables, or their functions, against the dependent variable, or its function, stepwise one at a time, and in combinations of up to four variables. The transformation of the variables into their functions (for example, AFR, the air/fuel ratio, could be expressed by its function $(AFR)^2$) was necessary in order to account for the inherent non-linear trends of the pollutants. The choice of a particular regression expression was based on the following considerations: predictive ability, statistical confidence, choice of variables from a practical viewpoint, and simplicity of the regression expression. It should be noted, however, that the expressions developed here are primarily from the standpoint of explaining the variance of piston aircraft emissions with engine and ambient parameters, rather than as absolute predictive expressions.

A first pass on the analyses showed up certain inconsistencies in the low power modes (idle and taxi). This was due to the inadequacy of the air/fuel ratio correction factor for hydrocarbon concentrations above 10,000 ppm. Hence in order to look at the true variance of the emissions with respect to the engine and ambient parameters, it was necessary to disregard these low power modes in the regression analyses. The following modes were therefore studied in the analyses of the carbureted and fuel injected piston aircraft engines: take off, climb, descent, descent with carburetor heat on, and approach.

Since the air/fuel ratios for the piston aircraft engines were computed from a knowledge of the measured carbon monoxide, carbon dioxide and total hydrocarbon emission levels, one would expect the air/fuel ratio to explain the variance of these particular emissions to a high degree. This is especially true in the case of carbon monoxide emissions. Table 7.2-10 presents the different combinations of variables considered in the regression matrix of the analysis.

Carbon Monoxide

As expected from the above discussion, the air/fuel ratio correlated with carbon monoxide to a high degree for both carbureted and injected engines. The equations are given below along with the correlation coefficients (r) and the percent contribution attributable to the regressions (V).

	r	V
For carbureted engines:		
$CO = 3.635 - 0.231(AFR)$	.989	98.0%
For injected engines:		
$CO = 3.690 - 0.236(AFR)$	.993	98.6%

This linear variance is significant to a little beyond the stoichiometric air/fuel ratio. Neglecting the air/fuel ratio as a contributing factor, regressions performed with exhaust gas temperature and BSFC as independent variables showed BSFC to explain to a very slight degree (about 0.3%) the source of the carbon monoxide variation. Exhaust gas temperature and humidity had no significant effect.

Total Hydrocarbons

Hydrocarbons emissions are known for their large variance even when tests are performed on the same engine under identical simulated conditions. Numerous combinations of variables, higher order terms and

TABLE 7.2-10 MATRIX OF VARIABLES USED IN REGRESSION ANALYSIS

Dependent Variable	Independent Variables										
CO	AFR										
CO		EGT									
CO		EGT	BSFC								
CO		EGT	BSFC	HUM							
CO	AFR	EGT	BSFC	HUM							
THC	AFR										
THC	AFR	EGT									
THC	AFR	EGT	BSFC								
THC				AFR^2							
THC	AFR			AFR^2							
THC	AFR		BSFC	AFR^2							
THC	AFR		BSFC	AFR^2	$AFR \cdot BSFC$						
THC	AFR			AFR^2		$BSFC^2$					
THC	AFP			AFR^2		$BSFC^2$	$BSFC \cdot AFR^2$				
THC	AFR			AFR^2		$BSFC^2$	$BSFC \cdot AFR^2$	$AFR \cdot BSFC^2$			
THC	AFR			AFR^2					$\frac{1}{BSFC}$		
THC	AFR			AFR^2					$\frac{1}{BSFC}$	$\frac{1}{BSFC^2}$	
THC	AFR			AFR^2							AFR/BSFC

TABLE 7.2-10 MATRIX OF VARIABLES USED IN REGRESSION ANALYSIS
(continued)

Dependent Variable	Independent Variables				
$\frac{1}{THC}$	AFR				
$\frac{1}{THC}$	AFR	EGT	BSFC		
$\frac{1}{THC}$	AFR			AFR^2	
$\frac{1}{THC}$	AFR	ECT		AFR^2	
$\frac{1}{THC}$	AFR	EGT	BSFC	AFR^2	
$\frac{1}{THC}$	AFR		BSFC	AFR^2	$BSFC^2$
$(\frac{1}{THC})^{\frac{1}{2}}$	AFR				
$(\frac{1}{THC})^{\frac{1}{2}}$	AFR	EGT			
$(\frac{1}{THC})^{\frac{1}{2}}$	AFR	EGT	BSFC		
$\log(\frac{1}{THC})$	AFR				
$\log_e(\frac{1}{THC})$	AFR	EGT			
$\log_e(\frac{1}{THC})$	AFR	EGT	BSFC		
$(\frac{1}{NOX})^{\frac{1}{2}}$	AFR				
$\log_e(\frac{1}{NOX}-1)$	AFR				
$\log_e(\frac{1}{NOX}-1)$	AFR	EGT			
$\log_e(\frac{1}{NOX}-1)$	AFR	EGT	BSFC		

TABLE 7.2-10 MATRIX OF VARIABLES USED IN REGRESSION ANALYSIS
(continued)

Dependent Variable	Independent Variables						
$\log_e(\frac{1}{NOX} - 1)$	AFR	EGT	BSFC	HUM			
$\log_e(\frac{1}{NOX} - 1)$	AFR	EGT	BSFC		$\frac{1}{HUM}$		
$\log_e(\frac{1}{NOX} - 1)$	AFR					EGT^2	
$\log_e(\frac{1}{NOX} - 1)$	AFR					EGT^2	$BSFC^2$
$\log_e(\frac{1}{NOX} - 1)$	AFR				$\frac{1}{HUM}$	EGT^2	$BSFC^2$

CO = carbon monoxide #/# fuel
THC = total hydrocarbons #/# fuel
NOX = nitrogen oxides #/# fuel
EGT = exhaust gas temperature ^oF
BSFC = brake specific fuel consumption #/BHP-hr
HUM = humidity grains H_2O/# dry air
AFR = air/fuel ratio

different regression models were tried in analyzing the hydrocarbon data (see Table 7.2-10). As was expected, in all the expressions considered, air/fuel ratio was by far the most predominant parameter in explaining the hydrocarbon variance. Exhaust gas temperature and BSFC contributed to a small extent. The following three equations were selected for carbureted engines.

	r	V
(3) $\frac{1}{\text{THC}} = 281.348-54.889(\text{AFR})+3.213(\text{AFR}^2)$	.526	27.6%
(4) $\frac{1}{\text{THC}} = 324.871-60.488(\text{AFR})-0.0131(\text{EGT})+3.483(\text{AFR}^2)$	.530	28.1%
(5) $\frac{1}{\text{THC}} = 282.614-55.971(\text{AFR})-0.0142(\text{EGT})+23.227(\text{BSFC})+3.339(\text{AFR}^2)$	.533	28.4%

Similarly, for injected engines:

	r	V
(6) $\frac{1}{\text{THC}} = 333.223=56.225(\text{AFR})+2.847(\text{AFR}^2)$	.487	23.8%
(7) $\frac{1}{\text{THC}} = 348.664-61.775(\text{AFR})+0.0161(\text{EGT})+3.058(\text{AFR}^2)$	.496	24.6%
(8) $\frac{1}{\text{THC}} = 446.727-86.241(\text{AFR})-0.0161(\text{EGT})+66.096(\text{BSFC})+4.214(\text{AFR}^2)$	.574	33.0%

As can be seen, the variance of hydrocarbon emissions in fuel injected engines is explained to a greater degree by BSFC than it is in carbureted engines. The major variance component in both cases is air/fuel ratio. Although the hydrocarbon emissions are dependent on the load conditions, the effect of BSFC is not felt as much as it might be due to the absence of the low power modes in the regression data. It can be concluded that there appears to be no definite trend in the hydrocarbon variation with respect to the engine parameters considered.

Nitrogen Oxides

In contrast to the hydrocarbon emissions, the variation of nitrogen oxide emissions shows a very definite trend with respect to the engine parameters. This was particularly so with respect to air/fuel ratio where low emissions are observed at rich mixtures, rapidly rising to a high emission level near a stoichiometric mixture. A stepwise multiple regression scheme resulted in the following equation for carbureted engines:

$$\begin{array}{lllc} & & r & V \\ (9)\ \log_e\left(\frac{1}{NOX}-1\right) = & 18.993-1.008(AFR)+0.000435(EGT) & & \\ & -4.895(BSFC)+7.908\left(\frac{1}{HUM}\right) & .762 & 58.3\% \end{array}$$

For injected engines:

$$\begin{array}{lllc} (10)\ \log_e\left(\frac{1}{NOX}-1\right) = & 18.054-1.118(AFR)+0.0000569(EGT) & & \\ & -0.342(BSFC)-17.912\left(\frac{1}{HUM}\right) & .918 & 84.2\% \end{array}$$

In the case of carbureted engines, of the 58.3% variance attributable to the regression, 42.3% is explained by air/fuel ratio, 0.7% by exhaust gas temperature, 15.1% by BSFC and about 0.3% by the humidity factor. The nitrogen oxide emissions from fuel injected engines correlated to a higher degree than in the case of carbureted engines. The air/fuel contribution amounted to nearly 83.7%. The contribution by exhaust gas temperature in this case was almost insignificant.

The fuel injected engines in general tend to have a better definition in the variations of their emissions than do the carbureted engines. It has been reported(3) that poor fuel/air distribution affects engine performance in carbureted engines due to the variance of air/fuel ratio between individual cylinders.

Aldehydes

The aldehyde emissions from both carbureted and fuel injected engines appeared to have the least dependence on the engine and ambient variables. Regression attempts made in a manner similar to the hydrocarbon regressions did not prove very successful, although there appeared some degree of variance attributable to air/fuel ratio.

Summary

The regression analyses performed showed that of the various engine and ambient parameters measured, only calculated air/fuel ratio had a major effect on emissions. This indicates that the large variations found from run to run were caused by either variations in unmeasured engine parameters or variations in the manner in which the engines were operated.

An examination of Runs 116 through 121 clearly shows that engine parameters rather than operational variations were prime contributors. The plane used in Runs 116 to 121 had two supposedly identical IO-470 engines with only 185 operational hours. Each engine had two exhausts, so in effect six runs were made on four half-engines with two runs being cold starts replicating two hot starts. A comparison of the two pairs of replicates (Runs 117 and 118 and Runs 119 and 120) shows very good repeatability even when runs were made on different days as was the case with Runs 117 and 118. On the other hand, a comparison of the hot start tests on the four half-engines shows a great number of dissimilarities between the two engines and even the two halves of each engine, especially at low power. The right engine consistently consumed nearly twice the fuel at low power as the left engine. The right bank of the left engine had both high hydrocarbons and nitric oxide at low idle, indicating very poor air/fuel distribution. Other dissimilarities are also apparent.

Thus, there is a very strong indication that run to run variations are primarily functions of how the engine adjustments have been set. Of course, this includes air/fuel ratio which was found to have a considerable effect on some pollutants. This does not mean that air temperature, humidity and engine design have no effect on emissions, but rather that within this test program they contributed less to the variation from run to run than did the engine settings which define air/fuel ratio, spark timing, etc.

7.3 CRANKCASE EMISSIONS

Measured crankcase emissions were converted to mass emission rates on a pound per minute and pound per pound of fuel basis as follows:

$$W_x = 4.2047 \sqrt{\frac{P}{T+459}} \quad C_x \quad Q \quad \rho_x$$

where: W_x = mass emission rate of constituent X in pounds per minute

P = sample pressure inches of mercury absolute

T = sample temperature, ^{o}F

C_x = measured concentration of constituent X expressed as a mole fraction.

Q = observed crankcase flow rate in cu. ft. per minute,

ρ_x = density of constituent X at standard conditions.

The constant 4.2047 and the expression under the radical correct the observed flow rate to standard conditions.

The mass emission rates for each test are presented in Appendix II on a mode basis. A summary of these data are presented in Table 7.3-1. The mean value of crankcase hydrocarbon emissions for all engines measured expressed as pounds per pound of fuel is relatively independent of mode. The crankcase contribution to the total hydrocarbon

TABLE 7.3-1 THE CONTRIBUTION OF HYDROCARBONS FROM CRANKCASE VENTILATION TO AIRCRAFT PISTON ENGINE EMISSIONS

Mode	Maximum #/# fuel	Minimum #/# fuel	Mean #/# fuel	Mean % Crankcase THC Contribution
Idle - low	.01028	.00034	.00387	3.5
Climb	.00705	.00104	.00379	20.3
Descent	.00766	.00127	.00463	24.2
Descent (Carb. Heat On)	.00836	.00297	.00529	19.3
Approach	.00716	.00191	.00514	24.6
Taxi	.01397	.00023	.00419	9.4

emissions ranged from less than 10% at low power to between 20 and 25% at high power. The contribution at high power was similar to that found for automobiles prior to installation of crankcase ventilation controls. The relative amounts of carbon monoxide and nitrogen oxides found in the crankcase blowby were much less than 1% of those in the exhaust.

8.0 DATA ANALYSIS - TURBINE ENGINES

Exhaust gas concentration data obtained from military turbine engines were converted to mass emission rates. Computer calculations of statistical parameters were made and the data organized into graphical illustrations to show the engine-to-engine variations for each of the three engine models tested.

8.1 TURBINE ENGINE MASS EMISSION CALCULATIONS

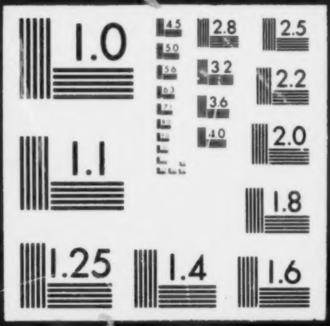
The technique described in Section 7.1 was used to calculate pollutant mass emission rate for the military gas turbines tested. The calculated emission rates in pounds per pound of fuel and pounds per minute have been combined with the measured exhaust emission concentrations, complete engine information and engine test conditions into a one page table for each turbine engine tested. These tables are contained in Appendix III. Summaries for the three engine models tested are presented in Tables 8.1-1, 8.1-2 and 8.1-3.

If the total hydrocarbon measurement was missing for a power setting other than idle, the calculation of mass emission rate was still possible since at the higher power settings, the fraction of total carbon in the exhaust which was contained as hydrocarbon was a negligible term in the equation. Therefore, when a total hydrocarbon measurement was missing in a high power mode, emission rates of all but hydrocarbons were calculated. A hydrogen to carbon mass ratio of .153 was used in the mass emission calculation. This value is a typical value for JP-5 fuel and corresponds to a hydrogen to carbon mole ratio of 1.84.

2 OF 3

PB

207107


1.0
4.5
5.0
5.6
6.3
7.1
8.0
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

8.0 DATA ANALYSIS - TURBINE ENGINES

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TABLE 8.1-1

```
SCOTT RESEARCH LABORATORIES                      SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA -TURBINE ENGINES

ENGINE :   J-52

                                                   ------------- #/# FUEL ------------

                          MODE            NO. OF    MAX        MIN       MEAN        STND      %COEF
                                            OBS    VALUE      VALUE                   DEV        VAR

        CO:
              IDLE                           6     .08974     .05893    .06872     .01200      17.46
              75% POWER                      5     .00795     .00211    .00475     .00234      49.34
              92% POWER(NORMAL)              7     .00360     .00143    .00229     .00091      39.69
              FULL POWER(MILITARY)           5     .00205     .00144    .00177     .00024      13.64
       CO2:
              IDLE                           6    3.07000    2.98000   3.00833     .03251       1.08
              75% POWER                      5    3.17000    3.17000   3.17000     .00000        .00
              92% POWER(NORMAL)              7    3.18000    3.17000   3.17714     .00488        .15
              FULL POWER(MILITARY)           5    3.18000    3.18000   3.18000     .00000        .00
       THC:
              IDLE                           5     .02515     .01662    .02222     .00359      16.15
              75% POWER                      5     .00107     .00008    .00048     .00040      83.83
              92% POWER(NORMAL)              4     .00020     .00002    .00008     .00008     100.14
              FULL POWER(MILITARY)           5     .00015     .00001    .00005     .00006     123.60
  NOX (NO2):
              IDLE                           5     .00536     .00268    .00385     .00122      31.79
              75% POWER                      4     .01004     .00565    .00754     .00205      27.35
              92% POWER(NORMAL)              6     .01229     .00652    .00992     .00249      25.15
              FULL POWER(MILITARY)           4     .01199     .00846    .01007     .00163      16.25
 ALD (HCHO):
              IDLE                           5     .00161     .00006    .00084     .00069      82.17
              75% POWER                      4     .00010     .00001    .00005     .00004      70.42
              92% POWER(NORMAL)              4     .00005     .00001    .00003     .00002      74.97
              FULL POWER(MILITARY)           4     .00004     .00001    .00002     .00001      51.64
```

TABLE 8.1-2

```
SCOTT RESEARCH LABORATORIES                              SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA -TURBINE ENGINES

ENGINE :   J-57

                                                ------------- #/# FUEL ------------

                           MODE          NO. OF      MAX        MIN       MEAN       STND      %COEF
                                          OBS       VALUE      VALUE                  DEV        VAR

      CO:
            IDLE                           10      .10558     .06427     .08830     .01013      11.47
            75% POWER                       8      .00601     .00323     .00441     .00095      21.60
            92% POWER(NORMAL)               8      .00341     .00227     .00270     .00035      12.94
            FULL POWER(MILITARY)            8      .00272     .00144     .00221     .00039      17.68
      CO2:
            IDLE                           10     2.88000    2.73000    2.78300     .04715       1.69
            75% POWER                       8     3.17000    3.17000    3.17000     .00000        .00
            92% POWER(NORMAL)               8     3.18000    3.16000    3.17375     .00744        .23
            FULL POWER(MILITARY)            8     3.19000    3.17000    3.17875     .00354        .11
      THC:
            IDLE                           10      .09512     .05294     .07986     .01359      17.02
            75% POWER                       7      .00200     .00015     .00101     .00084      83.33
            92% POWER(NORMAL)               6      .00136     .00004     .00050     .00064     126.19
            FULL POWER(MILITARY)            5      .00107     .00001     .00026     .00045     172.76
  NOX (NO2):
            IDLE                            9      .00413     .00124     .00263     .00105      40.08
            75% POWER                       7      .00716     .00525     .00604     .00076      12.59
            92% POWER(NORMAL)               7      .00973     .00628     .00771     .00120      15.61
            FULL POWER(MILITARY)            8      .01044     .00806     .00877     .00077       8.81
 ALD (HCHO):
            IDLE                            7      .00322     .00026     .00143     .00111      77.32
            75% POWER                       8      .00022     .00004     .00013     .00006      45.90
            92% POWER(NORMAL)               7      .00010     .00003     .00006     .00003      54.43
            FULL POWER(MILITARY)            6      .00007     .00001     .00003     .00002      64.81
```

TABLE 8.1-3

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
ANALYSIS OF AIRCRAFT EMISSIONS MASS DATA -TURBINE ENGINES

ENGINE : TF-33

	MODE	NO. OF OBS	MAX VALUE	MIN VALUE	MEAN	STND DEV	%COEF VAR
			#/# FUEL				
CO:							
	IDLE	13	.08633	.06488	.07155	.00746	10.43
	75% POWER	10	.00569	.00167	.00367	.00155	42.26
	92% POWER(NORMAL)	12	.00338	.00097	.00204	.00072	35.43
	FULL POWER(MILITARY)	14	.00201	.00054	.00136	.00042	31.07
CO2:							
	IDLE	13	3.04000	2.97000	3.01538	.02402	.80
	75% POWER	10	3.18000	3.17000	3.17500	.00527	.17
	92% POWER(NORMAL)	12	3.18000	3.17000	3.17833	.00389	.12
	FULL POWER(MILITARY)	14	3.18000	3.18000	3.18000	.00000	.00
THC:							
	IDLE	13	.02311	.00970	.01597	.00436	27.28
	75% POWER	8	.00058	.00001	.00012	.00019	158.73
	92% POWER(NORMAL)	9	.00033	.00001	.00008	.00010	137.72
	FULL POWER(MILITARY)	10	.00022	.00001	.00006	.00007	103.96
NOx (NO2):							
	IDLE	13	.00340	.00114	.00217	.00073	33.50
	75% POWER	9	.01115	.00337	.00715	.00204	28.57
	92% POWER(NORMAL)	11	.01465	.00569	.00970	.00283	29.13
	FULL POWER(MILITARY)	13	.01875	.01142	.01453	.00196	13.48
ALD (HCHO):							
	IDLE	11	.00152	.00011	.00077	.00046	60.37
	75% POWER	9	.00016	.00001	.00007	.00005	67.92
	92% POWER(NORMAL)	10	.00031	.00002	.00010	.00009	90.54
	FULL POWER(MILITARY)	12	.00011	.00001	.00005	.00003	61.60

8.2 ENGINE-TO-ENGINE VARIATIONS

The variations in exhaust emissions of the gas turbine engines tested are shown in Figure 8.2-1. The mean values are located with dots and the one-sigma limits are denoted by horizontal bars. At the high power settings, due to the distribution being skewed on the high side of the mean, it was not possible to plot the lower one-sigma limit, so instead, the maximum and minimum measured levels were indicated by an X.

The variation of emissions with changes in power setting followed patterns identified in many previous turbine emissions studies. Carbon monoxide was from ten to fifty times higher at idle than at the loaded conditions. Rates for all three engine models decreased with load from 75% to maximum power. Hydrocarbons were from fifty to several hundred times higher at idle than at the loaded conditions. Again the emissions diminished with increasing load. Nitrogen oxides emissions increased with load, but the average change was only a factor of three. Aldehydes were ten times as high at idle as the loaded conditions.

Aircraft gas turbine engine emissions varied much less from engine to engine than the aircraft piston engines tested during this program. J-57 engines emitted substantially more hydrocarbons than J-52 and TF-30 engines at all power settings. J-52's produced slightly more nitrogen oxides per pound of fuel than the J-57 and TF-30 at all modes except full power where the TF-30 produced more NO_x. Carbon monoxide emission rates varied little from engine to engine.

A comparison of exhaust emissions from turbine and piston engines on a pound per pound of fuel basis shows that carbon monoxide from turbine engines was ten times less at idle and about 400 times

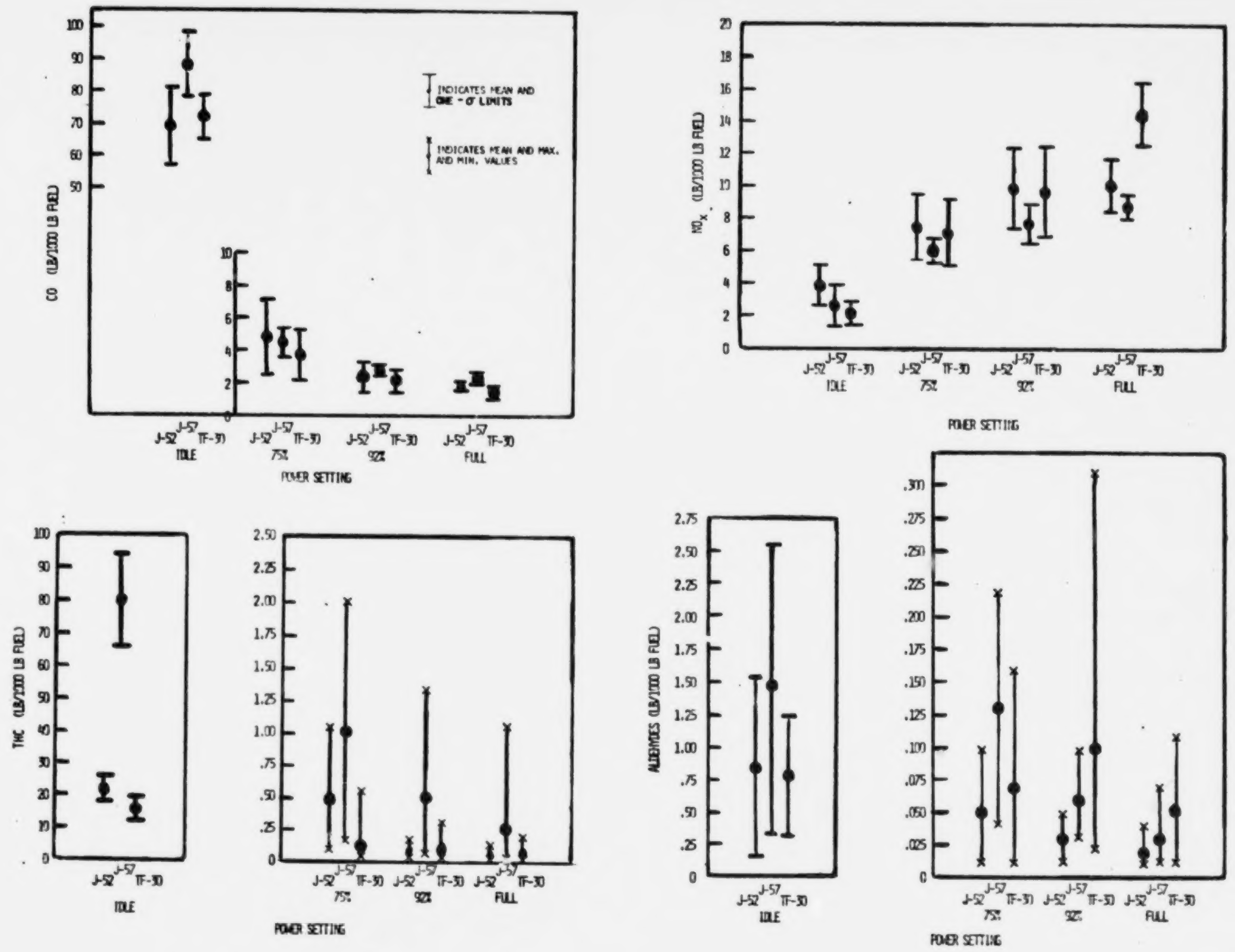

FIGURE 8.2-1 ENGINE TO ENGINE VARIATIONS IN EMISSION VS. POWER SETTING

Engines: J-52, J-57, & TF-30

less at load than piston engines. At idle, hydrocarbons from turbine engines were approximately the same as carburetor piston engines, but several times lower than from injected piston engines. At loaded conditions, hydrocarbons from turbine engines were about 50 times lower than piston engines. Nitrogen oxides from turbine engines were five times greater than piston engines at idle and twice as great at load. Aldehydes emissions from turbine engines were somewhat higher at idle and lower at load than piston engines.

9.0 REFERENCES

1. Obtained through a personal communication with George H. Amberg of Chevron Research Co. and based on work reported in: "Air Fuel Ratios From Exhaust Gas Analysis" by R. S. Spindt, SAE Report No. 650507; and "Fuel-Air Ratio and Distribution From Exhaust Gas Composition" by Eltinge, SAE Report No. 680114.

2. Hurn, R. W., Elwood, J. H., and Vaught, J., "Procedure For The Continuous Sampling And Measurement Of Gaseous Emissions From Aircraft Turbine Engines", Final Draft SAE E-31 Committee Paper 25 May, 1971.

3. J. H. Freeman, Jr. and R. C. Stahman, "Vehicle Performance and Exhaust Emissions, Carburetion Versus Timed Fuel Injection", SAE Paper 650863 presented at National Fuels and Lubricants Meeting, Tulsa, Oklahoma - November, 1965.

APPENDIX I

AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-007
                                                          ENGINE  2.PLANE  1


ENGINE TYPE AND MODEL: IO 360 A/B             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6967-51A
ENGINE TOTAL TIME:      62 HRS.                        TSMOH:          HRS.
FUEL : 100 OCTANE

                              START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F          77.5    80.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.10   30.10             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0106 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  51%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW   F/A TEMP
                         IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              600  10   16.4  170 .096          6.9  5.7 11494          7
IDLE/TAXI            1000  10   17.6  222 .079          4.3  7.4  3031          7
RUN UP               2000  19   46.9  562 .083          6.6  8.2  2910  209
TAKE OFF        FULL 2600  27   91.4 1026 .089          9.4  7.9  2243  125
CLIMB           75 % 2400  25   70.3  788 .089          9.2  7.7  2243  150    5
DESCENT         65 % 2250  23   62.1  686 .091          9.6  7.5  2496  146    5
APPROACH        40 % 2000  20   48.1  531 .091          9.6  7.5  2728  149    5
TAXI                 1000  10   18.8  197 .095          8.9  5.6  6062          9

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW          0.99822 1.29583 0.07813          0.00011     0.27285 0.35419 0.02135          0.00003
IDLE/TAXI         0.67788 1.97070 0.02500          0.00013     0.19885 0.57807 0.00733          0.00004
RUN UP            0.86740 1.69350 0.01862 0.00451              0.67802 1.32376 0.01455 0.00353
TAKE OFF          1.06386 1.40500 0.01236 0.00232              1.62061 2.14029 0.01882 0.00354
CLIMB             1.06554 1.40142 0.01265 0.00245 0.00006      1.24446 1.64204 0.01482 0.00334 0.00007
DESCENT           1.09749 1.34737 0.01393 0.00274 0.00006      1.13591 1.39453 0.01432 0.00284 0.00006
APPROACH          1.09597 1.34549 0.01516 0.00279 0.00006      0.87864 1.07864 0.01215 0.00224 0.00005
TAXI              1.16850 1.15538 0.03874          0.00013     0.36613 0.36202 0.01214          0.00004
```

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 12/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-008
                                                          ENGINE  2.PLANE  1


ENGINE TYPE AND MODEL: IO-360-A/B              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6967-51A
ENGINE TOTAL TIME:  62.45 HRS.                        TSMOH:          HRS.
FUEL : 100 OCTANE

                               START  FINISH
INLET AIR TEMP.-DEG.F           80.5    80.5        SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG        30.12   30.12          FLOW RATE    7 LPM
                                                      TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0107 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  49%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW             800  10  12.9  131 .098          6.1  6.3 20079   47  23
IDLE/TAXI           1000  10  18.8  230 .081          5.3  8.4  6286  150  14
RUN UP              2000  19  44.5  502 .089          8.6  7.5  3143  160
TAKE OFF       FULL 2600  28  93.8 1024 .092         10.3  7.6  2444   69
CLIMB          75 % 2400  25  71.5  777 .092         10.3  7.4  2346  100  10
DESCENT        65 % 2250  23  64.5  704 .092         10.2  7.5  2503  121   7
APPROACH       40 % 2000  20  44.5  484 .092         10.2  7.3  2794  123   4
TAXI                1000  10  17.6  165 .107         11.5  6.0 16936   44  12

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO      CO2     THC     NOX     ALD         CO      CO2     THC     NOX     ALD
                                           (NO2)  (HCHO)                                (NO2)  (HCHO)

IDLE-LOW          0.83970 1.36279 0.13455 0.00106 0.00034    0.18054 0.29300 0.02893 0.00023 0.00007
IDLE/TAXI         0.73361 1.82712 0.04235 0.00341 0.00021    0.22987 0.57250 0.01327 0.00107 0.00007
RUN UP            1.03913 1.42406 0.01849 0.00318            0.77069 1.05618 0.01371 0.00236
TAKE OFF          1.12588 1.30545 0.01300 0.00124            1.76012 2.04085 0.02033 0.00194
CLIMB             1.13879 1.28568 0.01284 0.00182 0.00012    1.35706 1.53214 0.01530 0.00216 0.00014
DESCENT           1.12700 1.30221 0.01346 0.00220 0.00008    1.21153 1.39987 0.01447 0.00236 0.00009
APPROACH          1.13783 1.27966 0.01517 0.00225 0.00005    0.84389 0.94908 0.01125 0.00167 0.00004
TAXI              1.18833 0.97428 0.08519 0.00075 0.00013    0.34858 0.28579 0.02499 0.00022 0.00004
```

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-009
                                                           ENGINE  2.PLANE  1


ENGINE TYPE AND MODEL: IO 360 A/B            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6967-51A
ENGINE TOTAL TIME:      63 HRS.                    TSMOH:          HRS.
FUEL : 100 OCTANE

                          START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F      85.5    87.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.10   30.10                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0107 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2   THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %   %     PPMC   PPM PPM

IDLE-LOW              800  10  16.4  182 .090  426  6.9  7.4 10028   46  15
IDLE/TAXI            1000  10  17.6  200 .088  471  7.4  7.5  6029   58   6
RUN UP               2000  19  46.9  549 .085  930  7.7  8.3  2626
TAKE OFF        FULL 2600  28 105.5 1146 .092 1211 10.9  7.8  2626  149
CLIMB           75 % 2500  24  73.8  810 .091 1267 10.3  7.8  2323  142   5
DESCENT         65 % 2250  23  64.5  708 .091 1233 10.3  7.8  2383  149   9
APPROACH        40 % 2000  20  46.9  513 .091 1076 10.3  7.7  2746  152   8
TAXI                 1000  10  18.8  182 .103  534  4.6  6.3 17904  132  27

EXHAUST EMISSION MASS DATA :

  TEST   CARB  ---------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE   HEAT
                  CO      CO2      THC      NOX     ALD        CO      CO2      THC      NOX     ALD
                                           (NO2)   (HCHO)                              (NO2)   (HCHO)

IDLE-LOW        0.89428 1.50713 0.06327 0.00098 0.00021    0.24444 0.41195 0.01729 0.00027 0.00006
IDLE/TAXI       0.97278 1.46986 0.03660 0.00119 0.00008    0.28535 0.43116 0.01074 0.00035 0.00002
RUN UP          0.93907 1.59066 0.01559                    0.73404 1.24337 0.01219
TAKE OFF        1.14005 1.28200 0.01337 0.00256            2.00459 2.25416 0.02351 0.00450
CLIMB           1.11431 1.32604 0.01226 0.00252 0.00006    1.37060 1.63103 0.01508 0.00310 0.00007
DESCENT         1.11394 1.32560 0.01257 0.00265 0.00010    1.19749 1.42503 0.01351 0.00285 0.00011
APPROACH        1.11785 1.31321 0.01451 0.00271 0.00009    0.87379 1.02649 0.01134 0.00212 0.00007
TAXI            1.07627 1.10990 0.09773 0.00243 0.00032    0.33723 0.34777 0.03062 0.00076 0.00010
```

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-010
                                                         ENGINE  1.PLANE  2


ENGINE TYPE AND MODEL: O-320-A2B              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : 26664
ENGINE TOTAL TIME:     257 HRS.                       TSMOH:          HRS.
FUEL : 90 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        84.5    96.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.32   30.32               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0104 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR  CALC EXH     CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                          IN.HG  #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW               800          6.4   78 .082  673  6.7   9.4   5100    24  10
IDLE/TAXI             1000          8.1  102 .080  706  5.9  10.0   2852    42  14
RUN UP                1700                   .090  998  9.6   7.6   3256    35
TAKE OFF        FULL  2200         70.3  734 .096 1412 11.6   6.9   4984    73
CLIMB           FULL  2200         70.3  734 .096 1412 11.6   6.9   4984    73  21
DESCENT         65 %  2000         39.2  459 .085 1323  8.3   8.8   2391   131  10
DESCENT    ON   65 %  1800         41.1  401 .102 1233 13.2   5.8   6195    20  13
APPROACH        40 %  1500         19.3  220 .088 1031  8.7   7.9   2968    66  11
TAXI                  1000         16.7  215 .078  807  5.2  10.5   2449    55  12


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW          0.80002 1.76380 0.02964 0.00047 0.00023     0.08534 0.18814 0.00316 0.00005 0.00002
IDLE/TAXI         0.72299 1.92563 0.01701 0.00085 0.00018     0.09760 0.25996 0.00230 0.00011 0.00002
RUN UP            1.00641 1.35155 0.01794 0.00367
TAKE OFF          1.21098 1.13194 0.02533 0.00125             1.41886 1.32625 0.02968 0.00147
CLIMB             1.21098 1.13194 0.02533 0.00125 0.00023     1.41886 1.32625 0.02968 0.00147 0.00028
DESCENT           0.94940 1.58178 0.01331 0.00190 0.00012     0.62027 1.03343 0.00870 0.00124 0.00008
DESCENT    ON     1.33439 0.92136 0.03049 0.00033 0.00014     0.91405 0.63113 0.02088 0.00023 0.00010
APPROACH          1.02120 1.45718 0.01696 0.00127 0.00014     0.32849 0.46873 0.00546 0.00041 0.00004
TAXI              0.64681 2.05238 0.01483 0.00112 0.00016     0.18003 0.57125 0.00413 0.00031 0.00004
```

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-011
                                                          ENGINE  1.PLANE  2


ENGINE TYPE AND MODEL: O-320-A2B               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : 26664
ENGINE TOTAL TIME:  257.3 HRS.                        TSMOH:         HRS.
FUEL : 80 OCTANE

                         START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F     84.5    84.9               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG  30.32   30.32               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0105 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  42%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW              800       10.6  141 .076  617  4.2 11.0  3841    34  16
IDLE/TAXI            1000        8.1  106 .076  751  4.7 10.9  2619    57  12
RUN UP               1700       30.9  338 .092  953 10.6  7.8  3841    43
TAKE OFF        FULL 2200       69.3  676 .103 1412 11.6  6.7 13619    42  34
CLIMB           FULL 2200       69.3  676 .103 1412 11.6  6.7 13619    42  34
DESCENT         65 % 2000       40.1  476 .084 1368  7.8  8.9  2444   104  10
DESCENT    ON   65 % 1800       41.1  403 .102 1222 12.9  5.7  6286    22   6
APPROACH        40 % 1500       21.1  238 .089 1054  8.9  7.8  3317    65   8
TAXI                 1000        5.6   73 .076  785  4.3 11.0  2561    57  10


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         1.53452 2.19989 0.02380 0.00071 0.00022    0.09443 0.38865 0.00420 0.00013 0.00004
IDLE/TAXI        1.58768 2.14171 0.01594 0.00117 0.00016    0.07934 0.28913 0.00215 0.00016 0.00002
RUN UP           1.11921 1.29418 0.01974 0.00075            0.57639 3.66650 0.01017 0.00438
TAKE OFF         1.17011 1.06204 0.06687 0.00070 0.00037    1.35148 1.22665 0.07724 0.00080 0.00042
CLIMB            1.17011 1.06204 0.06687 0.00070 0.00037    1.35148 1.22665 0.07724 0.00080 0.00042
DESCENT          0.91299 1.63702 0.01393 0.00200 0.00013    0.61013 1.09408 0.00931 0.00134 0.00008
DESCENT    ON    1.33057 0.92388 0.03156 0.00037 0.00007    0.91144 0.63285 0.02162 0.00025 0.00005
APPROACH         1.03640 1.42734 0.01890 0.00124 0.00010    0.36447 0.50195 0.00661 0.00044 0.00004
TAXI             0.54823 2.20385 0.01589 0.00119 0.00014    0.05117 0.20569 0.00148 0.00011 0.00001
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES
RUN P-012
ENGINE 1.PLANE 2

ENGINE TYPE AND MODEL : 0-320-A2B
ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : 26664
ENGINE TOTAL TIME: 250 HRS.
TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	85.5	84.0
ATMOSPHERIC PRES.-IN.HG	30.32	30.28

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0104 # H20/# DRY AIR
RELATIVE HUMIDITY : 41%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		5.6	75	.074	583	3.1	11.2	4076	37	15
IDLE/TAXI			1000		7.2	97	.074	706	3.7	11.3	2532	57	9
RUN UP			1700		30.9	331	.094	1076	10.4	6.9	3928	51	
TAKE OFF		FULL	2200		69.3	724	.096	1390	11.4	6.8	7420	29	21
CLIMB		FULL	2200		69.3	724	.096	1390	11.4	6.8	7420	29	21
DESCENT		65 %	2000		41.1	481	.085	1345	8.1	8.7	2532	88	6
DESCENT	ON	65 %	1800		40.1	392	.102	1211	13.0	5.7	6897	20	
APPROACH		40 %	1500		19.3	221	.087	1009	8.7	8.1	3230	70	6
TAXI			1000		8.1	106	.076	735	4.6	10.8	2532	53	7

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.41550	2.35894	0.03247	0.00081	0.00022	0.03878	0.22017	0.00303	0.00008	0.00002
IDLE/TAXI		0.40110	2.30891	0.01603	0.00122	0.00013	0.05773	0.27707	0.00192	0.00015	0.00002
RUN UP		1.16582	1.21547	0.02143	0.00094		0.60040	0.62547	0.01104	0.00048	
TAKE OFF		1.19364	1.11885	0.03782	0.00050	0.00024	1.37866	1.29228	0.04368	0.00058	0.00027
CLIMB		1.19364	1.11885	0.03782	0.00050	0.00024	1.37866	1.29228	0.04368	0.00058	0.00027
DESCENT		0.94205	1.59002	0.01433	0.00168	0.00007	0.64531	1.08917	0.00982	0.00115	0.00005
DESCENT	ON	1.32974	0.91621	0.03434	0.00034		0.88871	0.61233	0.02295	0.00022	
APPROACH		1.00771	1.47433	0.01821	0.00133	0.00007	0.32415	0.47424	0.00586	0.00043	0.00002
TAXI		0.58284	2.15036	0.01562	0.00110	0.00010	0.07868	0.29030	0.00211	0.00015	0.00001

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-013
                                                           ENGINE  1.PLANE  3


ENGINE TYPE AND MODEL: O-320-E2D                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-23495-27A
ENGINE TOTAL TIME: 526.73 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                             START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F         80.0    80.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.09   30.09                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0149 # H20/# DRY AIR               TEST START : COLD
RELATIVE HUMIDITY :  68%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW              800          5.6   69 .080  560   5.3   8.7   3860    29   14
IDLE/TAXI            1000          8.1  100 .081  560   5.5   8.3   2835    45    9
RUN UP               1700         26.4  323 .082 1009   6.3   9.9   2412   258
RUN UP-L.            1575         23.7  292 .081  953   5.5   8.2   2111   162
RUN UP-R.            1575.        24.6  305 .081 1043   5.9   8.9   1990   163
TAKE OFF         FULL 2300        51.5  611 .084 1334   7.5   8.6   2352   173
CLIMB            FULL 2300        51.5  611 .084 1177   7.5   8.6   2352   173    9
DESCENT          65 % 2000        35.5  451 .079 1256   5.4   9.8   2232   465    2
DESCENT    ON    65 % 2000        35.5  420 .085 1222   7.3   8.3   2714   268    4
APPROACH         40 % 1500        14.1  173 .081  964   5.9   8.7   2473   163    7
TAXI                 1000          6.4   88 .073  650   2.3   9.1   1628    85    9

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE     HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW          0.73369 1.88482 0.02590 0.00066 0.00021      0.06823 0.17592 0.00242 0.00006 0.00002
IDLE/TAXI         0.77455 1.83678 0.01943 0.00104 0.00014      0.10456 0.24797 0.00262 0.00014 0.00002
RUN UP            0.88920 1.79638 0.01508 0.00566              0.35605 0.79041 0.00664 0.00249
RUN UP-L.         0.78415 1.83714 0.01465 0.00379              0.30974 0.72567 0.00579 0.00150
RUN UP-R.         0.78016 1.84935 0.01281 0.00354              0.31987 0.75823 0.00525 0.00145
TAKE OFF          0.91061 1.64093 0.01390 0.00345              0.78161 1.40838 0.01193 0.00296
CLIMB             0.91061 1.64093 0.01390 0.00345 0.00012      0.78161 1.40838 0.01193 0.00296 0.00010
DESCENT           0.69441 1.98035 0.01397 0.00982 0.00003      0.41096 1.17171 0.00827 0.00531 0.00002
DESCENT    ON     0.91223 1.62987 0.01651 0.00558 0.00005      0.53973 0.96434 0.00977 0.00326 0.00003
APPROACH          0.78813 1.82626 0.01608 0.00358 0.00010      0.18521 0.42917 0.00378 0.00084 0.00002
TAXI              0.39451 2.45284 0.01359 0.00240 0.00017      0.04208 0.26164 0.00145 0.00026 0.00002
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-014
                                                        ENGINE  1.PLANE  3


ENGINE TYPE AND MODEL: O-320-E2D                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-23495-27A
ENGINE TOTAL TIME:  527.0 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                              START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F          85.5    85.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.[illegible]   30.[illegible]              TRANS. TIME [illegible] SEC.

INLET AIR HUMIDITY: .0152 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  58%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG  #/HR #/HR       DEG.F   %     %    PPMC   PPM PPM

IDLE-LOW              800          4.7   65 .073  516   1.7   8.7   4795   46  21
IDLE/TAXI            1000          6.4   85 .075  560   3.3   9.4   2262   70  13
RUN UP               1700         24.6  304 .081  998   6.1   9.1   2503  291
RUN UP-L.            1575         22.0  275 .080  942   5.6   9.1   1900  143
RUN UP-R.            1575         22.0  271 .081 1054   6.2   9.1   2201  160
TAKE OFF        FULL 2300         53.5  715 .075        4.2  11.5   1478  971
CLIMB           FULL 2300         53.5  715 .075        4.2  11.5   1478  971   7
DESCENT         65 % 2000         39.2  497 .079 1199   5.6  10.1   2141  478   7
DESCENT    ON   65 % 2000         34.6  404 .086 1143   8.0   8.5   2804  253   5
APPROACH        40 % 1500         15.8  197 .081  930   6.0   9.3   2443  158   7
TAXI                 1000          4.7   65 .073  605   2.3   9.3   1960   78   9


EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE     HEAT
                   CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.30991 2.49230 0.04255 0.00138 0.00041     0.02428 0.19523 0.00333 0.00011 0.00003
IDLE/TAXI        0.50634 2.26646 0.01689 0.00176 0.00021     0.05401 0.24176 0.00180 0.00019 0.00002
RUN UP           0.78305 1.83567 0.01564 0.00593             0.32105 0.75263 0.00641 0.00243
RUN UP-L.        0.74591 1.90475 0.01232 0.00313             0.27350 0.69841 0.00452 0.00115
RUN UP-R.        0.79231 1.82742 0.01369 0.00336             0.29051 0.67005 0.00502 0.00123
TAKE OFF         0.52563 2.26162 0.00900 0.01996             0.46868 2.01661 0.00803 0.01780
CLIMB            0.52563 2.26162 0.00900 0.01996 0.00009     0.46868 2.01661 0.00803 0.01780 0.00008
DESCENT          0.69791 1.97802 0.01299 0.00979 0.00009     0.45597 1.29230 0.00849 0.00639 0.00006
DESCENT    ON    0.94555 1.57873 0.01613 0.00491 0.00006     0.54527 0.91040 0.00930 0.00283 0.00004
APPROACH         0.76555 1.86467 0.01517 0.00352 0.00010     0.20160 0.49193 0.00400 0.00093 0.00003
TAXI             0.38671 2.45719 0.01604 0.00215 0.00016     0.03029 0.19248 0.00126 0.00017 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN 2-015
                                                          ENGINE  1.PLANE  3


ENGINE TYPE AND MODEL: 0-320-E2D                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-23495-27A
ENGINE TOTAL TIME:  527.3 HRS.                            TSMOH:         HRS.
FUEL : 80 OCTANE
                               START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F          89.0    89.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.10   30.10                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0125 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  43%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR        DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             800        6.4   83 .077  474   3.2   7.6   2490    37    8
IDLE/TAXI           1000        8.9  109 .082  628   5.7   8.8   2664    56    9
RUN UP              1700       26.4  321 .082 1331   6.6   8.9   2490   218
RUN UP-L.           1575       26.4  321 .082  897   5.9   8.8   2143    95
RUN UP-R.           1575       26.4  323 .082 1065   6.2   8.7   2085   136
TAKE OFF       FULL 2300       66.3  741 .089 1345   9.3   7.7   2664   106
CLIMB          FULL 2300       68.3  763 .089 1379   9.3   7.7   2606    73    6
DESCENT        65 % 2000       32.8  412 .080 1233   5.8   9.7   2316   393    8
DESCENT    ON  65 % 2000       35.5  415 .085 1188   7.9   8.3   2839   239   10
APPROACH       40 % 1500       15.0  191 .083  975   6.7   8.8   2664   116    8
TAXI                1000        6.4   88 .073  617   2.3   9.1   2316    49    3

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2       THC       NOX       ALD          CO       CO2       THC       NOX       ALD
                                                (NO2)     (HCHO)                                  (NO2)     (HCHO)

IDLE-LOW          0.57441 2.14378 0.02176 0.00109 0.00015      0.06127 0.22867 0.00232 0.00012 0.00002
IDLE/TAXI         0.80944 1.76524 0.01842 0.00131 0.00014      0.12007 0.26481 0.00273 0.00019 0.00002
RUN UP            0.83116 1.76128 0.01526 0.00451              0.36571 0.77496 0.00672 0.00198
RUN UP-L.         0.82906 1.76653 0.01466 0.00219              0.35479 0.77727 0.00645 0.00096
RUN UP-R.         0.81339 1.79469 0.01332 0.00293              0.35911 0.78966 0.00586 0.00129
TAKE OFF          1.06826 1.38989 0.01490 0.00290              1.18043 1.53582 0.01646 0.00221
CLIMB             1.06862 1.39035 0.01458 0.00138 0.00007      1.21644 1.58264 0.01659 0.00157 0.00008
DESCENT           0.73122 1.92172 0.01421 0.00814 0.00011      0.39974 1.05054 0.00777 0.00445 0.00006
DESCENT    ON     0.94423 1.57890 0.01572 0.00475 0.00013      0.55867 0.93418 0.00989 0.00241 0.00008
APPROACH          0.84283 1.73956 0.01631 0.00240 0.00011      0.21071 0.43499 0.00428 0.00050 0.00003
TAXI              0.39218 2.43833 0.01922 0.00137 0.00005      0.04183 0.26009 0.00205 0.00015 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-016
                                                          ENGINE  3.PLANE  1


ENGINE TYPE AND MODEL: O-470-R                   ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 203247-70R
ENGINE TOTAL TIME:  181.4 HRS.                       TSMOH:          HRS.
FUEL : 80 OCTANE
                              START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F          89.5    89.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       29.09   29.09            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0123 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  41%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN  FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR      DEG.F    %     %    PPMC   PPM PPM

IDLE-LOW                700  15   10.6  114 .093          8.3  7.4 10493   16  29
IDLE/TAXI              1000  16   15.0  180 .083          6.8  8.7  2294   48  12
RUN UP                 1700  20   35.5  466 .076          4.7 10.8  1089  169
RUN UP-L.              1500  21   35.5  459 .077          5.1 10.4   866   99
RUN UP-R.              1550  21   35.5  463 .077          4.9 10.6   917   92
TAKE OFF          FULL 2500  27  108.8 1247 .087          8.8  8.3  1950  180
CLIMB             75 % 2450  23  101.0 1318 .077          4.9 10.7   975  199   5
DESCENT           65 % 2100  22   57.4  745 .077          5.0 10.6   975  169   3
DESCENT     ON    65 % 2000  23   49.6  509 .097         11.6  6.4  3211   21   1
APPROACH          40 % 1000  22   44.8  567 .079          5.9 10.0  1147  124   2
TAXI                   1000  17   12.4  152 .081          6.5  9.4  1892   32   2


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.98283 1.37697 0.06048 0.00031 0.00037     0.17363 0.24327 0.01069 0.00005 0.00007
IDLE/TAXI         0.85742 1.72384 0.01408 0.00099 0.00016     0.21435 0.43096 0.00352 0.00025 0.00004
RUN UP            0.59720 2.15646 0.00674 0.00353             0.35334 1.27591 0.00399 0.00209
RUN UP-L.         0.64898 2.07964 0.00533 0.00207             0.38398 1.23046 0.00315 0.00122
RUN UP-R.         0.62330 2.11886 0.00568 0.00171             0.36879 1.25366 0.00336 0.00101
TAKE OFF          1.00915 1.49571 0.01089 0.00339             1.82993 2.71222 0.01974 0.00615
CLIMB             0.61910 2.12444 0.00600 0.00413 0.00007     1.04215 3.57613 0.01009 0.00695 0.00011
DESCENT           0.63174 2.10458 0.00600 0.00351 0.00004     0.60436 2.01338 0.00574 0.00336 0.00004
DESCENT    ON     1.25575 1.08873 0.01692 0.00037 0.00001     1.03808 0.90001 0.01399 0.00031 0.00001
APPROACH          0.73068 1.94613 0.00691 0.00252 0.00003     0.54559 1.45311 0.00516 0.00188 0.00002
TAXI              0.80126 1.82089 0.01135 0.00065 0.00003     0.16559 0.37632 0.00235 0.00013 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-017
                                                        ENGINE  3.PLANE  1


ENGINE TYPE AND MODEL: O-470-R       .         ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 203247-70R
ENGINE TOTAL TIME:  181.7 HRS.                        TSMOH:         HRS.
FUEL : 80 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        91.0    91.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.95   29.95              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0123 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN  FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR     DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW             700   16  10.6  122 .087          7.2  7.4   9395    10  30
IDLE/TAXI           1000   17  15.0  183 .082          6.1  8.5   2009    41  11
RUN UP              1700   21  35.5  446 .080          5.6  9.2   1359   122
RUN UP-L.           1500   21  34.6  437 .079          5.1  9.9   1084    70
RUN UP-R.           1550   20  34.6  442 .078          5.0  9.3   1004    70
TAKE OFF        FULL 2500  27 106.6 1233 .086          7.9  7.9   1832   150   8
CLIMB           75 % 2450  23 101.0 1319 .077          4.7 10.2    827    94   8
DESCENT         65 % 2100  22  52.5  675 .078          5.1  9.9    768    73   6
DESCENT     ON  65 % 2000  24  60.3  643 .094          9.8  6.4   1773    22   4
TAXI                1000   17  11.5  145 .079          5.5  9.4   1536    45   2

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW        0.91895 1.44417 0.05837 0.00021 0.00041     0.16235 0.25520 0.01031 0.00004 0.00007
IDLE/TAXI       0.81192 1.79477 0.01302 0.00090 0.00016     0.20298 0.44869 0.00325 0.00022 0.00004
RUN UP          0.74362 1.91976 0.00878 0.00266             0.43998 1.13586 0.00520 0.00157
RUN UP-L.       0.71736 1.96720 0.00687 0.00162             0.41368 1.13442 0.00396 0.00093
RUN UP-R.       0.68854 2.01279 0.00673 0.00176             0.39711 1.16071 0.00388 0.00102
TAKE OFF        0.98030 1.54047 0.01107 0.00306 0.00011     1.74167 2.73694 0.01966 0.00543 0.00019
CLIMB           0.62216 2.12178 0.00533 0.00204 0.00011     1.04731 3.57166 0.00897 0.00344 0.00019
DESCENT         0.67090 2.04652 0.00492 0.00169 0.00008     0.58704 1.79071 0.00430 0.00147 0.00007
DESCENT     ON  1.18681 1.21795 0.01845 0.00044 0.00005     1.19274 1.22404 0.01858 0.00044 0.00005
TAXI            0.72463 1.94616 0.00985 0.00097 0.00003     0.13889 0.37301 0.00189 0.00019 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-018
                                                      ENGINE  3.PLANE  1


ENGINE TYPE AND MODEL: O-470-R                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 20347-70R
ENGINE TOTAL TIME:  102.0 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F        91.0    91.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.95   29.95                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0123 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG  #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               700   16    8.9   104 .086  762  7.3  7.9   8569    13  29
IDLE/TAXI             1000   17   14.1   174 .081  942  6.1  9.1   1959    52  18
RUN UP                1700   21   34.6   442 .078 1323  5.4 10.0   1199   114
RUN UP-L.             1500   21   34.6   443 .078 1267  5.3  9.9    965    93
RUN UP-R.             1550   21   34.6   445 .078 1334  5.2 10.1    965    95
CLIMB            75 % 2450   23  102.1  1173 .087 1581  8.3  7.9   1609    26   8
DESCENT          65 % 2100   22   53.5   683 .078 1569  5.4  9.9    790    89   3
DESCENT     ON   65 % 2000   24   51.5   543 .095 1457 10.3  6.4   2252    23   4
APPROACH         40 % 1800   22   35.5   439 .081 1270  6.0  8.9   1199   121  14
TAXI                  1000   17   12.4   156 .079 1031  5.4  9.3   1726    53  13


EXHAUST EMISSION MASS DATA :

  TEST     CARB  --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE     HEAT
                      CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                  (NO2)    (HCHO)

IDLE-LOW           0.90169 1.53340 0.05152 0.00026 0.00038     0.13375 0.22745 0.00764 0.00004 0.00006
IDLE/TAXI          0.78582 1.84216 0.01228 0.00118 0.00025     0.18467 0.43291 0.00289 0.00026 0.00006
RUN UP             0.69008 2.00817 0.00746 0.00239             0.39795 1.15805 0.00430 0.00138
RUN UP-L.          0.68719 2.01713 0.00609 0.00198             0.39628 1.16321 0.00351 0.00114
RUN UP-R.          0.66985 2.04451 0.00605 0.00201             0.38628 1.17900 0.00349 0.00115
CLIMB              1.00616 1.50491 0.00949 0.00052 0.00010     1.71215 2.56085 0.01616 0.00089 0.00018
DESCENT /          0.69640 2.00631 0.00496 0.00189 0.00004     0.62096 1.78896 0.00442 0.00168 0.00004
DESCENT     ON     1.20698 1.17852 0.01285 0.00044 0.00005     1.03599 1.01156 0.01103 0.00038 0.00004
APPROACH           0.79228 1.84677 0.00771 0.00262 0.00020     0.46877 1.09267 0.00456 0.00155 0.00012
TAXI               0.72012 1.94889 0.01120 0.00116 0.00019     0.14882 0.40277 0.00232 0.00024 0.00004
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-019
                                                          ENGINE  4.PLANE  1



ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204598-9-A
ENGINE TOTAL TIME:  283.7 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                               START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F           77.5    79.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG        30.01   30.01              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0132 # H20/# DRY AIR               TEST START : COLD
RELATIVE HUMIDITY :  64%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              800        5.6   63 .088  336  3.7  4.0  5803   16  18
IDLE/TAXI            1200       11.5  120 .095  460  4.8  3.3  4616   20  13
RUN UP               1700       17.6  201 .087  807  4.4  4.4  2128  140
RUN UP-L.            1600       18.4  203 .091  796  5.0  4.1  2736   93
RUN UP-R.            1550       16.7  194 .086  887  4.1  4.5  1797   95
TAKE OFF        FULL 2600       49.6  538 .092 1110  6.5  4.7  1852  198
CLIMB           FULL 2600       49.6  538 .092 1110  6.5  4.7  1852  198    5
DESCENT         65 % 2400       32.8  395 .083 1076  4.1  5.3  1297  322    5
DESCENT    ON   65 % 2300       39.2  387 .101  975  7.1  3.4  2736   57    6
APPROACH        40 % 1950       22.0  246 .089  874  4.8  4.2  1852  155    6
TAXI                 1200        8.9   99 .091  493  4.3  3.5  2294   17    6


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.89489 1.52027 0.05890 0.00064 0.00047       0.08352 0.14189 0.00550 0.00006 0.00004
IDLE/TAXI        1.11194 1.20129 0.05205 0.00076 0.00032       0.21312 0.23025 0.00998 0.00015 0.00006
RUN UP           0.96825 1.52154 0.02280 0.00506               0.28402 0.44632 0.00669 0.00148
RUN UP-L.        1.05794 1.36323 0.02818 0.00323               0.32443 0.41806 0.00864 0.00099
RUN UP-R.        0.92619 1.59743 0.01976 0.00353               0.25779 0.44462 0.00550 0.00098
TAKE OFF         1.13232 1.28661 0.01570 0.00567               0.93605 1.06360 0.01298 0.00469
CLIMB            1.13232 1.28661 0.01570 0.00567 0.00009       0.93605 1.06360 0.01298 0.00469 0.00008
DESCENT          0.85328 1.73332 0.01316 0.01101 0.00011       0.46646 0.94755 0.00719 0.00602 0.00006
DESCENT    ON    1.30705 0.98358 0.02452 0.00172 0.00012       0.85394 0.64260 0.01602 0.00113 0.00008
APPROACH         1.03645 1.42512 0.01947 0.00550 0.00014       0.38003 0.52254 0.00714 0.00202 0.00005
TAXI             1.06214 1.35855 0.02758 0.00150 0.00016       0.15755 0.20152 0.00409 0.00022 0.00002
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN R-020
                                                       ENGINE  4.PLANE  1


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204598-9-A
ENGINE TOTAL TIME:  284.0 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                           START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       82.5    82.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.00   30.00               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0126 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  56%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH   CO  CO2   THC   NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %   %    PPMC  PPM PPM

IDLE-LOW             800        6.4   81 .079  247  3.3  5.8  1596   63  14
IDLE/TAXI           1200        9.8  107 .091  370  5.7  4.3  1241   40  12
RUN UP              1700       19.3  230 .084  639  4.7  5.5   768  227
RUN UP-L.           1650       16.7  199 .084  568  4.4  5.2   946  144
RUN UP-R.           1625       16.7  198 .084  695  4.8  5.5   709  159
TAKE OFF       FULL 2575       51.5  559 .092 1099  7.0  4.9   591  174
CLIMB          FULL 2575       51.5  559 .092 1099  7.0  4.9   591  174   8
DESCENT        65 % 2400       35.5  431 .082 1087  4.6  6.0   552  338   9
DESCENT   ON   65 % 2225       38.3  378 .101  975  8.1  3.9  1025   50   3
APPROACH       40 % 1950       22.0  247 .089  874  5.7  4.9   729  179   6
TAXI                1200        8.1   98 .092  471  6.2  4.5  1143   53   9

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                            (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW        0.73693 1.95221 0.01664 0.00222 0.00032    0.07540 0.20824 0.00178 0.00024 0.00003
IDLE/TAXI       1.11644 1.32374 0.01183 0.00129 0.00025    0.18230 0.21621 0.00193 0.00021 0.00004
RUN UP          0.90706 1.66800 0.00722 0.00720            0.29177 0.53654 0.00232 0.00232
RUN UP-L.       0.90016 1.67172 0.00962 0.00484            0.25954 0.46530 0.00262 0.00135
RUN UP-R.       0.91795 1.65286 0.00660 0.00500            0.25550 0.46005 0.00184 0.00139
TAKE OFF        1.16090 1.27699 0.00477 0.00474            0.99644 1.09609 0.00410 0.00407
CLIMB           1.16090 1.27699 0.00477 0.00474 0.00014    0.99644 1.09609 0.00410 0.00407 0.00012
DESCENT         0.85623 1.75501 0.00500 0.01034 0.00018    0.50662 1.03834 0.00296 0.00612 0.00011
DESCENT   ON    1.33847 2.98674 0.00824 0.00136 0.00005    0.85439 0.62947 0.00526 0.00087 0.00003
APPROACH        1.05922 1.43088 0.00659 0.00546 0.00012    0.38938 0.52466 0.00242 0.00200 0.00004
TAXI            1.13707 1.29689 0.01020 0.00160 0.00018    0.15351 0.17509 0.00138 0.00022 0.00002
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-021
                                                           ENGINE  4.PLANE  1


ENGINE TYPE AND MODEL: O-200-A                 ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204554-9-A
ENGINE TOTAL TIME:  204.3 HRS.                       TSMOH:          HRS.
FUEL : 80 OCTANE

                             START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        82.0    81.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.02   30.02                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0116 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  51%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH   CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F  %    %   PPMC  PPM PPM

IDLE-LOW             800        3.9   47 .082  291  3.2  4.6  2860   30  13
IDLE/TAXI           1200        8.9   97 .092  437  5.0  3.7  1268   37  12
RUN UP              1700       16.7  196 .085  762  4.6  5.0   845  201
RUN UP-L.           1630       16.7  197 .085  695  4.4  5.0   881  132
RUN UP-R.           1650       16.7  200 .084  796  4.3  5.2   810  173
TAKE OFF       FULL 2575       50.6  565 .089 1256  5.9  4.8   669  191
CLIMB          FULL 2575       50.6  565 .089 1256  5.9  4.8   669  191   7
DESCENT        65 % 2400       35.5  430 .083 1233  4.3  5.6   524  311   5
DESCENT        65 % 2300       44.8  449 .100 1499  7.4  3.7  1109   76   7
APPROACH       40 % 1950       22.0  245 .090  998  5.5  4.5   740  142   7
TAXI                1200        8.1   87 .093  583  5.7  4.0  1109   44  10

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                           (NO2)   (HCHO)                                   (NO2)   (HCHO)

IDLE-LOW        0.79274 1.79074 0.02404 0.00122 0.00035     0.05153 0.11640 0.00161 0.00008 0.00002
IDLE/TAXI       1.12347 1.30644 0.01397 0.00137 0.00029     0.16665 0.19379 0.00206 0.00020 0.00004
RUN UP          0.94206 1.64910 0.00842 0.00676             0.26221 0.45897 0.00234 0.00188
RUN UP-L.       0.91975 1.64241 0.00896 0.00453             0.25600 0.45714 0.00250 0.00126
RUN UP-R.       0.89013 1.69154 0.00816 0.00549             0.24775 0.47081 0.00227 0.00164
TAKE OFF        1.08682 1.38944 0.00600 0.00548             0.91655 1.17176 0.00506 0.00462
CLIMB           1.08682 1.38944 0.00600 0.00548 0.00014     0.91655 1.17176 0.00506 0.00462 0.00012
DESCENT         0.85598 1.75361 0.00512 0.01019 0.00011     0.50699 1.03755 0.00303 0.00602 0.00006
DESCENT         1.30914 1.02861 0.00955 0.00221 0.00013     0.97749 0.76803 0.00713 0.00165 0.00010
APPROACH        1.00242 1.39220 0.00709 0.00459 0.00015     0.36753 0.51047 0.00260 0.00168 0.00005
TAXI            1.15229 1.27070 0.01091 0.00146 0.00022     0.15556 0.17154 0.00147 0.00020 0.00003
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-022
                                                         ENGINE  4.PLANE  2


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213378-71A
ENGINE TOTAL TIME:   43.1 HRS.                        TSMOH:          HRS.
FUEL : 80 OCTANE

                          START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F      70.0    72.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.24   30.23              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0122 # H20/# DRY AIR          TEST START : COLD
RELATIVE HUMIDITY :  76%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR     DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW           800       5.6   64 .087  258  6.1  6.5  6911   11  10
IDLE/TAXI         1200       8.1   94 .086  314  5.7  6.1  3415   33  20
RUN UP            1700      12.4  135 .091  560  7.0  5.4  2555   92
RUN UP-L.         1600      13.2  145 .091  493  6.4  5.0  2770   64
RUN UP-R.         1650      14.1  162 .087  605  6.8  6.8  2555   70
TAKE OFF     FULL 2600      49.6  537 .092 1121  9.8  6.9  1802  148
CLIMB        FULL 2600      49.6  537 .092 1121  9.8  6.9  1802  148   6
DESCENT      65 % 2400      35.5  425 .084 1054  6.5  7.9  1640  233  13
DESCENT   ON 65 % 2225      44.8  480 .093 1043  9.8  6.5  2501  569   6
APPROACH     40 % 1950      22.0  238 .092  818  8.6  6.1  2286   74   4
TAXI              1200       5.6   66 .084  392  5.6  6.7  2393   47   6

EXHAUST EMISSION MASS DATA :

  TEST   CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE   HEAT
                 CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                          (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW       0.91026 1.52420 0.05020 0.00027 0.00016     0.08496 0.14226 0.00469 0.00003 0.00001
IDLE/TAXI      0.93110 1.55584 0.02716 0.00089 0.00035     0.12570 0.21139 0.00367 0.00012 0.00005
RUN UP         1.09702 1.32986 0.01949 0.00237             0.22672 0.27484 0.00403 0.00049
RUN UP-L.      1.08744 1.33453 0.02290 0.00179             0.23915 0.29360 0.00504 0.00039
RUN UP-R.      0.97338 1.52960 0.01780 0.00165             0.22874 0.35946 0.00419 0.00039
TAKE OFF       1.15145 1.27398 0.01031 0.00286             0.95186 1.05315 0.00852 0.00236
CLIMB          1.15145 1.27398 0.01031 0.00286 0.00008     0.95186 1.05315 0.00852 0.00236 0.00006
DESCENT        0.88517 1.69858 0.01087 0.00521 0.00019     0.52373 1.00026 0.00643 0.00308 0.00011
DESCENT   ON   1.17441 1.22406 0.01459 0.01120 0.00008     0.87690 0.91397 0.01089 0.00836 0.00006
APPROACH       1.14255 1.27351 0.01478 0.00162 0.00006     0.41993 0.46695 0.00542 0.00459 0.00002
TAXI           0.88575 1.66530 0.01842 0.00122 0.00010     0.08267 0.15543 0.00172 0.00011 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-023
                                                         ENGINE  4.PLANE  2


ENGINE TYPE AND MODEL: O-200-A                ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213378-71A
ENGINE TOTAL TIME:   43.4 HRS.                        TSMOH:          HRS.
FUEL : 80 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         72.0    72.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.23   30.23              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0125 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  75%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR       DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW             800          3.9   46 .084  179  4.7  6.4  4699    15  10
IDLE/TAXI           1200          8.1   97 .083  280  4.9  6.5  3593    54   8
RUN UP              1700         15.0  180 .083  527  5.5  7.2  2432   170
RUN UP-L.           1625         13.2  161 .082  471  4.8  6.8  2985   141
RUN UP-R.           1675         13.2  158 .083  583  5.7  7.1  2266   122
TAKE OFF       FULL 2600         49.6  536 .093 1476  9.6  6.7  1935   181
CLIMB          FULL 2600         49.6  536 .093 1076  9.6  6.7  1935   191   6
DESCENT        65 % 2400         35.5  423 .084 1054  6.6  7.8  1714   255   9
DESCENT   ON   65 % 2400         42.0  458 .093 1031  9.6  6.5  2487   627   7
APPROACH       40 % 1950         20.2  220 .092       8.3  6.1  2322    94   6
TAXI                1200          6.4   76 .084       5.4  6.5  2377    54  10

EXHAUST EMISSION MASS DATA :

  TEST    CARB  ---------------- #/# FUEL ----------------     ---------------- #/ MIN ----------------
  MODE    HEAT
                  CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                  (NO2)    (HCHO)

IDLE-LOW        0.80568 1.72401 0.03921 0.00042 0.00033      0.05237 0.11206 0.00255 0.00003 0.00002
IDLE/TAXI       0.82644 1.72275 0.02950 0.00139 0.00014      0.11157 0.23257 0.00398 0.00019 0.00002
RUN UP          0.84278 1.73373 0.01814 0.00428              0.21070 0.43343 0.00454 0.00107
RUN UP-L.       0.80010 1.78118 0.02422 0.00277              0.17602 0.39186 0.00533 0.00061
RUN UP-R.       0.86784 1.69870 0.01679 0.00305              0.19092 0.37371 0.00369 0.00067
TAKE OFF        1.15439 1.26605 0.01133 0.00358              0.95430 1.04660 0.00936 0.00296
CLIMB           1.15439 1.26605 0.01133 0.00358 0.00008      0.95430 1.04660 0.00936 0.00296 0.00006
DESCENT         0.89834 1.66834 0.01136 0.00570 0.00012      0.53151 0.98710 0.00672 0.00337 0.00007
DESCENT   ON    1.16462 1.23914 0.01469 0.01250 0.00009      0.81523 0.86740 0.01028 0.00875 0.00006
APPROACH        1.12503 1.29930 0.01532 0.00209 0.00009      0.37976 0.43743 0.00516 0.00070 0.00003
TAXI            0.88237 1.66904 0.01991 0.00145 0.00018      0.09412 0.17803 0.00202 0.00015 0.00002
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-024
ENGINE 4.PLANE 2

ENGINE TYPE AND MODEL: O-200-A ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213370-71A
ENGINE TOTAL TIME: 43.7 HRS. TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	72.0	75.5
ATMOSPHERIC PRES.-IN.HG	30.23	30.23

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0129 # H20/# DRY AIR
RELATIVE HUMIDITY : 73%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		3.9	47	.083		5.0	6.7	4124	15	23
IDLE/TAXI			1200		6.4	76	.085		6.0	7.0	3385	49	16
RUN UP			1675		13.2	155	.085		6.5	7.3	2954	142	
RUN UP-L.			1600		15.0	178	.084		6.0	7.3	3077	85	
RUN UP-R.			1625		12.4	147	.084		6.4	7.6	2893	99	
TAKE OFF		FULL	2600		49.6	553	.090		9.1	7.4	2770	203	
CLIMB		FULL	2600		49.6	553	.090		9.1	7.4	2770	203	8
DESCENT		65 %	2400		35.5	423	.084		6.8	8.2	2277	287	9
DESCENT	ON	65 %	2250		42.0	422	.100		11.7	5.8	2770	178	11
APPROACH		40 %	1950		21.1	228	.093		9.4	6.6	2277	89	8
TAXI			1200		5.6	64	.087		7.4	7.2	2339	52	10

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.81872	1.72399	0.03287	0.00040	0.00040	0.05322	0.11206	0.00214	0.00003	0.00003
IDLE/TAXI		0.89215	1.63562	0.02450	0.00120	0.00025	0.09516	0.17447	0.00261	0.00013	0.00003
RUN UP		0.91460	1.61412	0.02023	0.00329		0.20121	0.35511	0.00445	0.00072	
RUN UP-L.		0.87450	1.67197	0.02183	0.00204		0.21863	0.41799	0.00546	0.00051	
RUN UP-R.		0.88831	1.65765	0.01955	0.00226		0.18358	0.34258	0.00404	0.00047	
TAKE OFF		1.07578	1.37470	0.01594	0.00394		0.88931	1.13642	0.01318	0.00326	
CLIMB		1.07578	1.37470	0.01594	0.00394	0.00010	0.88931	1.13642	0.01318	0.00326	0.00008
DESCENT		0.88567	1.67830	0.01444	0.00614	0.00013	0.52402	0.99299	0.00854	0.00363	0.00007
DESCENT	ON	1.39534	1.01686	0.01504	0.00326	0.00013	0.91374	0.71180	0.01053	0.00228	0.00009
APPROACH		1.14886	1.26759	0.01355	0.00179	0.00010	0.40402	0.44577	0.00476	0.00063	0.00004
TAXI		0.99940	1.51275	0.01522	0.00114	0.00014	0.09234	0.14119	0.00142	0.00011	0.00001

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-025
                                                         ENGINE  4.PLANE  3


ENGINE TYPE AND MODEL: O-200-A                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 205317-9-A
ENGINE TOTAL TIME:  289.1 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        78.5    78.0                FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG     30.30   30.30                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0136 # H2O/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  67%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               800         4.7   53 .089  247   6.9   6.6   7396     9  21
IDLE/TAXI             1200         8.1   90 .090  336   7.3   6.8   2853    27  13
RUN UP                1700        16.7  190 .088  572   7.7   7.1   2325    84
RUN UP-L.             1625        16.7  194 .086  538   6.7   7.1   2377    78
RUN UP-R.             1675        15.8  179 .088  594   7.8   7.0   2166    64
TAKE OFF         FULL 2525        58.6  543 .093 1065  10.9   7.3   2377   409
CLIMB            FULL 2525        58.6  543 .093 1065  10.9   7.3   2377   409   8
DESCENT          65 % 2400        35.5  416 .085 1009   7.6   8.1   1638   186   8
DESCENT    ON    65 % 2225        44.8  470 .095  986  11.3   6.8   3962   473  13
APPROACH         40 % 1950        22.9  249 .092  807   8.9   6.6   2113    74   9
TAXI                  1200         7.2   83 .087  381   7.2   7.0   2272    43  11

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE     HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.96105 1.44456 0.05015 0.00021 0.00031     0.07528 0.11316 0.00393 0.00002 0.00002
IDLE/TAXI         1.06574 1.37649 0.02028 0.00065 0.00020     0.14387 0.18583 0.00274 0.00009 0.00003
RUN UP            1.01591 1.47203 0.01493 0.00182             0.28276 0.40972 0.00416 0.00051
RUN UP-L.         0.94662 1.57635 0.01635 0.00181             0.26348 0.43875 0.00455 0.00050
RUN UP-R.         1.03019 1.45284 0.01393 0.00139             0.27129 0.38258 0.00367 0.00037
TAKE OFF          1.17251 1.23398 0.01245 0.00723             0.98881 1.04065 0.01050 0.00610
CLIMB             1.17251 1.23398 0.01245 0.00723 0.00009     0.98881 1.04065 0.01050 0.00610 0.00008
DESCENT           0.95017 1.59136 0.00997 0.00382 0.00011     0.56218 0.94155 0.00590 0.00226 0.00006
DESCENT    ON     1.21169 1.14582 0.02068 0.00833 0.00015     0.90473 0.85555 0.01544 0.00622 0.00011
APPROACH          1.12350 1.30925 0.01298 0.00153 0.00012     0.42880 0.49970 0.00496 0.00059 0.00005
TAXI              0.98980 1.51219 0.01520 0.00097 0.00016     0.11878 0.18146 0.00182 0.00012 0.00002
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-026
                                                           ENGINE  4.PLANE  3


ENGINE TYPE AND MODEL: O-200-A                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 205317-9-A
ENGINE TOTAL TIME:  289.4 HRS.                           TSMOH:         HRS.
FUEL : 80 OCTANE

                          START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F      79.0    78.5                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.28   30.28                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0135 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  65%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR        DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             800          3.9   46 .084  202  5.6   7.0  5916    17  21
IDLE/TAXI           1200          7.2   84 .086  336  6.3   6.7  2497    41  13
RUN UP              1700         16.7  193 .086  560  6.9   7.1  2334   144
RUN UP-L.           1625         15.8  185 .085  527  6.3   7.0  3311    83
RUN UP-R.           1650         14.1  169 .083  572  6.0   7.6  1900    93
TAKE OFF       FULL 2500         49.6  535 .093 1054 10.5   7.2  2225   292
CLIMB          FULL 2500         49.6  535 .093 1054 10.5   7.2  2225   292   9
DESCENT        65 % 2400         35.5  417 .085 1020  7.4   8.0  1628   193   8
DESCENT    ON  65 % 2225         44.8  464 .097 1009 11.1   6.3  2551   158   7
APPROACH       40 % 1950         22.0  238 .092  818  8.7   6.2  2171    77  14
TAXI                1200          6.4   74 .087  415  6.7   6.7  2334    43   9


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW         0.94195 1.65383 0.04330 0.00042 0.00034     0.05473 0.10750 0.00281 0.00003 0.00002
IDLE/TAXI        0.94304 1.57601 0.01819 0.00101 0.00021     0.11316 0.18912 0.00218 0.00012 0.00003
RUN UP           0.96147 1.55468 0.01583 0.00234             0.26761 0.43272 0.00441 0.00056
RUN UP-L.        0.91665 1.60051 0.02345 0.00198             0.24139 0.42147 0.00618 0.00052
RUN UP-R.        0.86294 1.71767 0.01330 0.00196             0.20279 0.40345 0.00313 0.00046
TAKE OFF         1.16195 1.25206 0.01199 0.00531             0.96054 1.03503 0.00991 0.00439
CLIMB            1.16195 1.25206 0.01199 0.00531 0.00011     0.96054 1.03503 0.00991 0.00439 0.00009
DESCENT          0.94306 1.60211 0.01010 0.00404 0.00011     0.55798 0.94792 0.00598 0.00239 0.00006
DESCENT    ON    1.24695 1.11214 0.01395 0.00292 0.00008     0.93185 0.83040 0.01042 0.00219 0.00006
APPROACH         1.14142 1.27024 0.01387 0.00166 0.00020     0.41852 0.46869 0.00508 0.00051 0.00007
TAXI             0.97469 1.53166 0.01653 0.00103 0.00014     0.10397 0.16334 0.00176 0.00011 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-027
                                                         ENGINE  4.PLANE  3



ENGINE TYPE AND MODEL: O-200-A                ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 205317-9-A
ENGINE TOTAL TIME:  289.7 HRS.                           TSMOH:         HRS.
FUEL : 80 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         80.5    80.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.28   30.28              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0139 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  64%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW              800        3.9   45 .086  224  6.1  7.2  9199   15  32
IDLE/TAXI            1200        7.2   82 .088  392  7.7  7.1  3935   38  16
RUN UP               1700       15.8  177 .089  673  8.2  6.9  3066   72
RUN UP-L.            1625       15.8  182 .087  617  7.5  7.3  2849   64
RUN UP-R.            1675       16.7  186 .090  717  8.6  7.0  2849   68
TAKE OFF        FULL 2550       49.6  553 .090 1121  9.6  7.9  2632  435
CLIMB           FULL 2550       49.6  553 .090 1121  9.6  7.9  2632  435   9
DESCENT         65 % 2400       35.5  422 .084 1065  7.5  8.7  1872  208  11
DESCENT    ON   65 % 2225       43.9  430 .102 1020 12.9  5.7  7734   84  18
APPROACH        40 % 1950       22.0  234 .094  852  9.7  6.4  2795   68  10
TAXI                 1200        6.4   71 .090  482  8.4  6.9  3718   59   9


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.85080 1.57807 0.06246 0.00034 0.00048     0.05530 0.10257 0.00406 0.00002 0.00003
IDLE/TAXI        1.04514 1.45643 0.02500 0.00081 0.00022     0.12062 0.17477 0.00300 0.00010 0.00003
RUN UP           1.05561 1.39583 0.01921 0.00152             0.27798 0.36757 0.00506 0.00040
RUN UP-L.        0.93609 1.50824 0.01823 0.00138             0.25967 0.39717 0.00480 0.00036
RUN UP-R.        1.07377 1.37342 0.01732 0.00139             0.29886 0.38227 0.00482 0.00039
TAKE OFF         1.07188 1.38611 0.01431 0.00798             0.88609 1.14585 0.01183 0.00660
CLIMB            1.07188 1.38611 0.01431 0.00798 0.00011     0.88609 1.14585 0.01183 0.00660 0.00009
DESCENT          0.90772 1.65465 0.01103 0.00414 0.00014     0.53707 0.97900 0.00653 0.00245 0.00008
DESCENT    ON    1.32063 0.91698 0.03054 0.00141 0.00020     0.96626 0.67092 0.02020 0.00103 0.00014
APPROACH         1.17454 1.21778 0.01647 0.00135 0.00013     0.43066 0.44652 0.00604 0.00050 0.00005
TAXI             1.06306 1.37221 0.02290 0.00123 0.00012     0.11339 0.14637 0.00244 0.00013 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-028
                                                          ENGINE  1.PLANE  4


ENGINE TYPE AND MODEL: O-320-E2D                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26284-27A
ENGINE TOTAL TIME:   4261 HRS.                          TSMOH:         HRS.
FUEL : 80 OCTANE

                          START  FINISH                SAMPLE LINE :
INLET AIR TEMP.-DEG.F      82.0    82.5                  FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.17   30.17                  TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0171 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  73%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT           PRES   FLOW FLOW   F/A TEMP
                         IN.HG #/HR #/HR        DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW                800      6.4   74 .086  460  7.5   7.9   6548    12  34
IDLE/TAXI              1000     12.4  128 .097  437  8.7   5.2   9372     6  28
RUN UP                 1700     26.4  326 .081  807  5.9   8.7   1926   232
RUN UP-L.              1600     26.4  325 .081  740  5.6   8.2   1990   120
RUN UP-R.              1625     26.4  324 .082  863  6.2   8.7   1797   130
TAKE OFF          FULL 2325     69.3  781 .089 1368  9.5   8.2   1797    59
CLIMB             FULL 2325     69.3  781 .089 1368  9.5   8.2   1797    59   9
DESCENT           65 % 2000     37.4  481 .078 1165  5.4  10.6   1476   588  10
DESCENT    ON     65 % 1975     40.1  504 .080 1166  6.2  10.2   1605   633  12
APPROACH          40 % 1500     17.6  213 .083  807  6.8   8.9   2118   167  18
TAXI                   1000      8.1   94 .086  516  7.2   7.4   3210    37  15

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------      ---------------- #/ MIN ---------------
  MODE    HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW           0.92651 1.53360 0.03938 0.00024 0.00045      0.09883 0.16358 0.00420 0.00003 0.00005
IDLE/TAXI          1.16296 1.09230 0.06098 0.00013 0.00040      0.24034 0.22574 0.01260 0.00003 0.00008
RUN UP             0.79105 1.83301 0.01257 0.00511              0.34806 0.80652 0.00553 0.00225
RUN UP-L.          0.79339 1.82561 0.01372 0.00279              0.34909 0.80327 0.00604 0.00123
RUN UP-R.          0.81545 1.79811 0.01151 0.00281              0.35880 0.79117 0.00506 0.00124
TAKE OFF           1.05382 1.42937 0.00970 0.00108              1.21714 1.65092 0.01121 0.00124
CLIMB              1.05380 1.42937 0.00970 0.00108 0.00011      1.21714 1.65092 0.01121 0.00124 0.00012
DESCENT            0.66326 2.04592 0.00982 0.01186 0.00013      0.41343 1.27529 0.00550 0.00740 0.00008
DESCENT    ON      0.74253 1.91963 0.00936 0.01245 0.00015      0.49626 1.28295 0.00625 0.00832 0.00010
APPROACH           0.84759 1.74326 0.01285 0.00342 0.00024      0.24863 0.51135 0.00377 0.00100 0.00007
TAXI               0.95704 1.54570 0.02077 0.00081 0.00021      0.12920 0.20867 0.00280 0.00011 0.00003
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-029
                                                         ENGINE  1.PLANE  4


ENGINE TYPE AND MODEL: O-320-E2D              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26284-27A
ENGINE TOTAL TIME:    4264 HRS.                      TSMOH:          HRS.
FUEL : 80 OCTANE

                              START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F          81.5    81.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.16   30.16              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0164 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  72%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH     CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F    %     %     PPMC   PPM PPM

IDLE-LOW              800          5.6   73 .076  348   3.6   9.6   3018    29  18
IDLE/TAXI            1000          8.9  103 .086  415   7.9   7.1   2952    25  19
RUN UP               1700         26.4  321 .082  818   6.1   8.3   2559   217
RUN UP-L.            1600         26.4  321 .082  717   5.7   7.9   2493   103
RUN UP-R.            1625         26.4  322 .082  863   6.3   8.7   2559   115
TAKE OFF        FULL 2325         67.3  752 .089 1368   9.7   8.1   2624    60
CLIMB           FULL 2325         67.3  752 .089 1368   9.7   8.1   2624    60  10
DESCENT         65 % 2000         38.3  491 .078 1166   5.3  10.4   2427   451  16
DESCENT    ON   65 % 1960         39.2  490 .080 1155   6.2   9.9   2427   495  11
APPROACH        40 % 1500         17.6  212 .083  785   6.8   8.7   2559   118  17
TAXI                               7.2   88 .082  516   5.8   8.1   2559    37  24

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE     HEAT
                    CO      CO2       THC       NOX       ALD          CO      CO2       THC       NOX       ALD
                                                (NO2)    (HCHO)                                    (NO2)    (HCHO)

IDLE-LOW          0.52882 2.21600 0.02158 0.00070 0.00028     0.04936 0.20683 0.00201 0.00007 0.00003
IDLE/TAXI         0.96444 1.53720 0.01980 0.00057 0.00028     0.14306 0.22802 0.00294 0.00008 0.00004
RUN UP            0.82549 1.76505 0.01686 0.00482             0.36322 0.77662 0.00742 0.00212
RUN UP-L.         0.81629 1.77783 0.01738 0.00242             0.35917 0.78224 0.00765 0.00107
RUN UP-R.         0.81903 1.77735 0.01619 0.00246             0.36037 0.78203 0.00713 0.00108
TAKE OFF          1.06510 1.39765 0.01403 0.00108             1.19469 1.56770 0.01573 0.00121
CLIMB             1.06510 1.39765 0.01403 0.00108 0.00012     1.19469 1.56770 0.01573 0.00121 0.00013
DESCENT           0.65934 2.03311 0.01470 0.00922 0.00021     0.42088 1.29780 0.00938 0.00589 0.00014
DESCENT    ON     0.75243 1.88800 0.01434 0.00987 0.00014     0.49158 1.23349 0.00937 0.00645 0.00009
APPROACH          0.85598 1.72094 0.01568 0.00244 0.00023     0.25109 0.50481 0.00460 0.00072 0.00007
TAXI              0.81262 1.78336 0.01745 0.00085 0.00030     0.09751 0.21400 0.00209 0.00010 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-030
                                                          ENGINE  1.PLANE  4


ENGINE TYPE AND MODEL: O-320-E2D              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26294-27A
ENGINE TOTAL TIME:   4267 HRS.                        TSMOH:          HRS.
FUEL : 80 OCTANE

                              START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F          85.0    85.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.16   30.15               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0170 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  66%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW  FLOW   F/A TEMP
                           IN.HG  #/HR  #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               800         5.6    71 .078  280   3.4   7.0   3012    24   19
IDLE/TAXI             1000         8.9    97 .092  359   7.4   5.5   3338    17   15
RUN UP                1700        27.3   322 .085  740   6.1   6.9   2307   199
RUN UP-L.             1625        25.5   300 .085  673   5.5   6.2   2307   100
RUN UP-R.             1650        26.4   313 .084  785   5.8   6.8   2307   110
TAKE OFF          FULL 2325        69.3   741 .093 1323   9.7   6.5   2741    59
CLIMB             FULL 2325        69.3   741 .093 1323   9.7   6.5   2741    59   11
DESCENT           65 % 2000        36.4   455 .080 1110   5.3   8.6   2144   444    9
DESCENT    ON     65 % 1975        39.2   473 .083 1121   6.2   8.0   2198   468   11
APPROACH          40 % 1500        17.6   204 .086  751   6.9   7.2   2524   132   12
TAXI                  1000         8.1    95 .085  493   6.0   6.6   2632    35   18


EXHAUST EMISSION MASS DATA :

  TEST     CARB   ---------------- #/# FUEL ----------------    ----------------- #/ MIN ----------------
  MODE     HEAT
                    CO      CO2      THC      NOX     ALD          CO      CO2      THC      NOX     ALD
                                              (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW          0.63015 2.03871 0.02717 0.00073 0.00038      0.05881 0.19028 0.00254 0.00007 0.00004
IDLE/TAXI         1.10903 1.29529 0.02435 0.00042 0.00024      0.16451 0.19214 0.00361 0.00006 0.00004
RUN UP            0.91441 1.62539 0.01683 0.00490              0.41606 0.73955 0.00766 0.00223
RUN UP-L.         0.91431 1.61963 0.01867 0.00273              0.38858 0.68834 0.00793 0.00116
RUN UP-R.         0.89655 1.65177 0.01736 0.00279              0.39448 0.72678 0.00764 0.00123
TAKE OFF          1.16779 1.22971 0.01606 0.00117              1.34880 1.42031 0.01855 0.00135
CLIMB             1.16779 1.22971 0.01606 0.00117 0.00014      1.34880 1.42031 0.01855 0.00135 0.00016
DESCENT           0.74475 1.89901 0.01467 0.01025 0.00014      0.45181 1.15205 0.00890 0.00622 0.00008
DESCENT    ON     0.85276 1.72910 0.01472 0.01058 0.00016      0.55714 1.12968 0.00961 0.00691 0.00011
APPROACH          0.95350 1.56350 0.01698 0.00300 0.00018      0.27969 0.45863 0.00498 0.00088 0.00005
TAXI              0.92512 1.59914 0.01975 0.00089 0.00030      0.12489 0.21598 0.00267 0.00012 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                    RUN P-031
                                                            ENGINE  2.PLANE  2


ENGINE TYPE AND MODEL : IO-360-A1B6            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-7682-51A
ENGINE TOTAL TIME:     660 HRS.                       TSMOH:          HRS.
FUEL  : 80 OCTANE

                           START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F       89.0    90.5                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.13   30.13                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0176 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  59%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               800  14   22.3  207 .108  415  8.4   3.2  7958    12  86
IDLE/TAXI             1000  13   23.4  231 .101  471 10.0   4.7  7706     3  73
RUN UP                1800  18   36.3  353 .103  762 13.9   5.8  5691    12
RUN UP-L.             1700  17   37.5  367 .102  717 12.6   5.6  5843    12
RUN UP-R.             1625  17   36.3  353 .103  785 12.3   5.3  5792     7
TAKE OFF         FULL 2700  25   85.6  950 .090 1099 10.3   8.2  4029   140
CLIMB            75 % 2500  25   82.0  896 .092 1166 10.8   7.9  3778    97  11
DESCENT          65 % 2350  23   64.5  700 .092 1132 10.8   7.7  3677    95   9
APPROACH         40 % 1900  20   44.5  429 .104  953 14.0   5.7  4634    23  11
TAXI                  1000  17   21.1  199 .106  527  9.0   3.6  6296     6  79

EXHAUST EMISSION MASS DATA :

  TEST    CARB   ---------------- #/# FUEL ----------------   ---------------- #/ MIN ----------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         1.34400 0.80457 0.06198 0.00032 0.00147     0.49952 0.29903 0.02304 0.00012 0.00055
IDLE/TAXI        1.28200 0.94685 0.04809 0.00006 0.00100     0.49998 0.36927 0.01876 0.00002 0.00039
RUN UP           1.36012 0.89183 0.02711 0.00019             0.82287 0.53956 0.01640 0.00012
RUN UP-L.        1.33037 0.92914 0.03003 0.00021             0.83148 0.58072 0.01877 0.00013
RUN UP-R.        1.34192 0.90864 0.03076 0.00013             0.81186 0.54973 0.01861 0.00008
TAKE OFF         1.08070 1.35200 0.02058 0.00241             1.54180 1.92885 0.02936 0.00344
CLIMB            1.12277 1.29059 0.01912 0.00166 0.00012     1.53445 1.76381 0.02613 0.00226 0.00017
DESCENT          1.13527 1.27193 0.01882 0.00164 0.00010     1.22042 1.36732 0.02023 0.00176 0.00011
APPROACH         1.37708 0.88105 0.02219 0.00037 0.00012     1.02134 0.65345 0.01646 0.00028 0.00009
TAXI             1.34925 0.84810 0.04595 0.00015 0.00127     0.47449 0.29825 0.01616 0.00005 0.00045
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-032
                                                          ENGINE  2.PLANE  2


ENGINE TYPE AND MODEL: IO-360-A1B6            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-7682-51A
ENGINE TOTAL TIME:     663 HRS.                         TSMOH:         HRS.
FUEL : 80 OCTANE

                           START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       89.0    89.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.12   30.12               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0173 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  59%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %     PPMC  PPM PPM

IDLE-LOW            800  16  14.1  139 .101  303  5.3  3.0  7514   27  90
IDLE/TAXI          1000  12  14.1  140 .095  404  6.4  4.5  7969   39  53
RUN UP             1800  14  34.0  329 .104  717 11.8  5.0  7008   15
RUN UP-L.          1675  13  34.0  331 .103  650 10.1  4.5  6806   10
RUN UP-R.          1675  14  34.0  335 .101  740 10.0  4.7  6553   12
TAKE OFF      FULL 2700  23  96.1 1056 .091 1177 10.0  7.6  3820  102
CLIMB         75 % 2500  25  82.0  928 .088 1143  9.3  8.2  4478  156
DESCENT       65 % 2350  23  66.8  735 .091 1155  9.8  7.6  3668  115  10
APPROACH      40 % 1900  20  44.5  444 .100  964 12.6  6.0  4478   35   5
TAXI               1000  13  14.1  136 .104  538  8.3  3.7  6198   14  79

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW        1.16133 1.03299 0.08015 0.00097 0.00211    0.27291 0.24275 0.01883 0.00023 0.00050
IDLE/TAXI       1.08519 1.19904 0.06578 0.00109 0.00096    0.25502 0.28177 0.01546 0.00026 0.00023
RUN UP          1.33727 0.89044 0.03866 0.00028            0.75779 0.50458 0.02191 0.00016
RUN UP-L.       1.31092 0.91783 0.04300 0.00021            0.74286 0.52010 0.02437 0.00012
RUN UP-R.       1.29163 0.95396 0.04120 0.00025            0.73192 0.54058 0.02335 0.00014
TAKE OFF        1.10295 1.31724 0.02051 0.00185            1.76657 2.10978 0.03285 0.00296
CLIMB           1.02770 1.42394 0.02409 0.00283            1.40453 1.94606 0.03292 0.00387
DESCENT         1.09399 1.33320 0.01993 0.00211 0.00012    1.21797 1.48429 0.02219 0.00235 0.00013
APPROACH        1.31196 0.98174 0.02270 0.00060 0.00006    0.97304 0.72812 0.01683 0.00044 0.00004
TAXI            1.30443 0.91378 0.04742 0.00036 0.00133    0.30654 0.21474 0.01114 0.00008 0.00031
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES               RUN P-033
                                                        ENGINE  2.PLANE  2


ENGINE TYPE AND MODEL: IO-360-A1B6              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-7682-51A
ENGINE TOTAL TIME:    666 HRS.                      TSMOH:          HRS.
FUEL : 80 OCTANE

                             START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F         89.0    89.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.11   30.11               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0171 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  58%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW FLOW  F/A TEMP
                          IN.HG  #/HR #/HR      DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              800   12   14.1  146 .097  325  6.0  3.3            15  53
IDLE/TAXI            1000   11   14.1  127 .110  415  6.5  4.2 20210      16  74
RUN UP               1800   15   34.0  341 .100  751 10.0  5.4  5826      23
RUN UP-L.            1700   15   34.0  344 .099  695  9.9  5.2  5826      18
RUN UP-R.            1675   15   32.8  333 .099  807 10.0  5.3  5106      20
TAKE OFF        FULL 2700   23   85.6  981 .087 1121  8.2  7.8  2373
CLIMB           75 % 2500   25   84.4  921 .092 1155  9.5  7.0  2230      98  40
DESCENT         65 % 2500   25   66.8  738 .090 1143  9.0  7.1  2661      57  21
APPROACH        40 % 2350   23   45.7  462 .099  975 11.1  5.7  4100          30
TAXI                 1000   12   12.9  110 .109  516  6.6  4.3 19203      35  21


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                               (NO2)    (HCHO)

IDLE-LOW
IDLE/TAXI        1.01342 1.12901 0.15330 0.00041 0.00124    0.23215 0.24182 0.03605 0.00010 0.00029
RUN UP           1.27632 1.02082 0.03352 0.00045            0.72325 0.56827 0.01899 0.00025
RUN UP-L.        1.25202 1.03342 0.03547 0.00037            0.70949 0.58560 0.02032 0.00021
RUN UP-R.        1.25443 1.04476 0.03118 0.00041            0.68576 0.57114 0.01704 0.00023
TAKE OFF         1.00160 1.49717 0.01411                    1.42995 2.13546 0.02013
CLIMB            1.12669 1.30459 0.01297 0.00191 0.00051    1.58488 1.83512 0.01811 0.00259 0.00071
DESCENT          1.09067 1.35208 0.01570 0.00113 0.00027    1.21420 1.50532 0.01748 0.00126 0.00030
APPROACH         1.27920 1.03225 0.02300         0.00037    0.97432 0.78623 0.01752         0.00028
TAXI             1.02104 1.04535 0.14461 0.00049 0.00035    0.21952 0.22475 0.03109 0.00019 0.00007
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-034
                                                         ENGINE  1.PLANE  5


ENGINE TYPE AND MODEL: O-320-E2D              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-28592-27A
ENGINE TOTAL TIME:    890 HRS.                         TSMOH:         HRS.
FUEL : 80 OCTANE

                              START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F         89.0    89.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.77   29.77             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0168 # H20/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  57%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC  PPM PPM

IDLE-LOW              800                .082  448   5.4  7.8   4144   19  21
IDLE/TAXI            1000                .086        5.7  5.9   2745   19  19
RUN UP               1700                .084        6.8  7.9   2261  132
RUN UP-L.            1600                .084        5.4  6.8   2853   68
RUN UP-R.            1625                .082        5.6  7.5   1830   76
TAKE OFF        FULL 2400       60.3  712 .085        7.3  8.2   1839
CLIMB           FULL 2400       60.3  712 .085        7.3  8.2   1830        9
DESCENT         65 % 2000       35.5  439 .081        5.2  7.8   1507        6
DESCENT    ON   65 % 2000       36.4  430 .085        7.0  7.8   1991
APPROACH        40 % 1500       16.7  207 .081        4.9  7.6   1722
TAXI                 1000        8.9  113 .079        3.8  6.9   1561       21

EXHAUST EMISSION MASS DATA :

  TEST    CARB   ---------------- #/# FUEL ----------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.78667 1.78561 0.02939 0.00045 0.00033
IDLE/TAXI        0.95204 1.54856 0.02232 0.00052 0.00034
RUN UP           0.90356 1.64957 0.01462 0.00288
RUN UP-L.        0.85781 1.69746 0.02206 0.00177
RUN UP-R.        0.83616 1.75977 0.01330 0.00186
TAKE OFF         0.92319 1.62958 0.01127                    0.92780 1.63773 0.01132
CLIMB            0.92319 1.62958 0.01127         0.00012    0.92780 1.63773 0.01132         0.00012
DESCENT          0.78424 1.84857 0.01106         0.00010    0.46401 1.09374 0.00655         0.00006
DESCENT    ON    0.92561 1.62076 0.01282                    0.56154 0.98326 0.00777
APPROACH         0.76690 1.86918 0.01312                    0.21345 0.52026 0.00365
TAXI             0.69423 1.98091 0.01388         0.00041    0.10294 0.29384 0.00206         0.00006
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-035
                                                         ENGINE  4.PLANE  4


ENGINE TYPE AND MODEL: O-200-A                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213 175-70-A
ENGINE TOTAL TIME:  31460 HRS.                         TSMOH:         HRS.
FUEL : 80 OCTANE

                             START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F         74.0   75.8             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.92  29.92             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0136 # H2O/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  73%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2   THC   NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F   %     %   PPMC  PPM PPM

IDLE-LOW             800         4.7   59 .079  314  4.3  8.1  4750   15  20
IDLE/TAXI           1200         7.2   87 .083  404  5.0  7.6  3726        14
RUN UP              1700        15.8  200 .079  620  4.7  8.6  3157  201
RUN UP-L.           1600        15.0  188 .080  650  4.6  8.1  3214  136
RUN UP-R.           1625                  .079  673  4.9  8.7  2816  131
TAKE OFF        FULL 2600       48.6  514 .095 1099 10.5  6.6  3328   92
CLIMB           FULL 2600       48.6  514 .095 1099 10.5  6.6  3328   92   6
DESCENT    ON   65 % 2400       40.1  426 .094 1031 14.0  6.4  3669  203   3
APPROACH        40 % 1950       22.0  244 .090 1097  8.5  6.8  3157   71   6
TAXI                 1200        6.4   79 .081  440  5.3  8.2  3271   58   6

EXHAUST EMISSION MASS DATA :

  TEST   CARB   --------------- #/# FUEL ---------------     --------------- #/ MIN ---------------
  MODE   HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.66239 1.96078 0.03562 0.00038 0.00033     0.05189 0.15359 0.00279 0.00003 0.00003
IDLE/TAXI        0.83523 1.71984 0.02612         0.00015     0.10023 0.20638 0.00313         0.00002
RUN UP           0.68463 1.96856 0.02239 0.00481             0.18028 0.51839 0.00589 0.00127
RUN UP-L.        0.70064 1.93873 0.02383 0.00465             0.17516 0.48468 0.00596 0.00116
RUN UP-R.        0.70849 1.95331 0.01959 0.00387
TAKE OFF         1.19459 1.17996 0.01843 0.00172             0.96762 0.95577 0.01493 0.00139
CLIMB            1.19459 1.17996 0.01843 0.00172 0.00007     0.96762 0.95577 0.01493 0.00139 0.00006
DESCENT    ON    1.18289 1.18965 0.02113 0.00394 0.00004     0.79056 0.79508 0.01412 0.00264 0.00003
APPROACH         1.07958 1.35718 0.01952 0.00148 0.00008     0.39584 0.49763 0.00716 0.00054 0.00003
TAXI             0.76022 1.84832 0.02284 0.00137 0.00009     0.08109 0.19715 0.00244 0.00015 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-036
                                                          ENGINE  4.PLANE  4


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213 175-70-A
ENGINE TOTAL TIME:  31085 HRS.                            TSMOH:         HRS.
FUEL : 80 OCTANE

                              START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F          75.8    77.8              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       29.93   29.93              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0120 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  65%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW            800          4.7   62 .076  247  2.8  8.3  4790    26  17
IDLE/TAXI          1200          7.2   92 .078  381  4.4  8.6  3229    68   9
RUN UP             1700         15.0  190 .079  684  5.0  9.3  2853   274
RUN UP-L.          1625         15.0  190 .079  650  4.7  8.9  2960   138
RUN UP-R.          1625         15.0  197 .076  706  3.9  9.6  2422   216
TAKE OFF        FULL 2600       49.6  525 .095 1087 10.7  6.8  6728   106
CLIMB           FULL 2600       49.6  525 .095 1087 10.7  6.8  6728   106   6
DESCENT         65 % 2400       33.7  401 .084 1054  6.7  8.2  4844   213   5
DESCENT    ON   65 % 2400       40.1  402 .100 1043 10.6  6.6 11303   298   9
APPROACH        40 % 1950       22.0  244 .090  863  8.7  7.0  3014   145   4
TAXI               1200          5.6   70 .080  448  5.4  8.4           62   5

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE    HEAT
                   CO       CO2       THC       NOX      ALD          CO       CO2       THC       NOX      ALD
                                               (NO2)    (HCHO)                                    (NO2)    (HCHO)

IDLE-LOW         0.47960 2.23407 0.03994 0.00073 0.00031     0.03757 0.17500 0.00313 0.00006 0.00002
IDLE/TAXI        0.65541 2.01182 0.02340 0.00147 0.00014     0.07869 0.24142 0.00281 0.00018 0.00002
RUN UP           0.67991 1.98727 0.01889 0.00612             0.16998 0.49682 0.00472 0.00153
RUN UP-L.        0.67082 1.99514 0.02057 0.00324             0.16770 0.49903 0.00514 0.00081
RUN UP-R.        0.56286 2.17724 0.01702 0.00512             0.14072 0.54431 0.00425 0.00128
TAKE OFF         1.16777 1.16621 0.03574 0.00190             0.96536 0.96407 0.02955 0.00157
CLIMB            1.16777 1.16621 0.03574 0.00190 0.00007     0.96536 0.96407 0.02955 0.00157 0.00006
DESCENT          0.86375 1.66121 0.03040 0.00451 0.00007     0.48514 0.93304 0.01707 0.00253 0.00004
DESCENT    ON    1.14692 1.12219 0.05953 0.00530 0.00010     0.76652 0.74999 0.03979 0.00354 0.00007
APPROACH         1.07834 1.36342 0.01819 0.00214 0.00005     0.39539 0.49992 0.00667 0.00078 0.00002
TAXI
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-037
                                                         ENGINE  4.PLANE  4


ENGINE TYPE AND MODEL: O-200-A                   ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 213 175-70-A
ENGINE TOTAL TIME:  3104 HRS.                              TSMOH:         HRS.
FUEL : 80 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        77.8    77.8               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.94   29.94               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0127 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  62%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW             800         4.7   62 .075  258  2.5  7.2  3007    19  15
IDLE/TAXI           1200         7.2   92 .078  392  3.9  7.4  1407    52   9
RUN UP              1700        15.0  193 .078  695  4.0  8.0  1186   297
RUN UP-L.           1625        14.1  179 .079  661  4.3  7.9  1297   142
RUN UP-R.           1625        14.1  184 .077  717  3.7  8.2  1021   186
TAKE OFF       FULL 2600        47.7  509 .094 1099  9.2  6.0  1517   152
CLIMB          FULL 2600        47.7  509 .094 1099  9.2  6.0  1517   152  10
DESCENT        65 % 2400        34.6  416 .083 1054  6.6  8.4  2383   253   7
DESCENT   ON   65 % 2400        40.1  421 .095 1043 10.7  6.5  4256   234   8
APPROACH       40 % 1950        22.0  244 .090  863  8.6  7.0  3064    72   5
TAXI                1200         5.6   69 .080  426  5.2  8.4  3022    93   4


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                     CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)


IDLE-LOW           0.49530 2.24384 0.02903 0.00062 0.00032      0.03884 0.17577 0.00227 0.00005 0.00002
IDLE/TAXI          0.67609 2.01590 0.01187 0.00148 0.00017      0.08113 0.24191 0.00142 0.00018 0.00002
RUN UP             0.65464 2.05744 0.00945 0.00799              0.16366 0.51436 0.00236 0.00200
RUN UP-L.          0.69735 1.98778 0.01024 0.00378              0.16383 0.46713 0.00241 0.00089
RUN UP-R.          0.61142 2.12935 0.00821 0.00585              0.14368 0.50043 0.00193 0.00119
TAKE OFF           1.18858 1.21811 0.00954 0.00323              0.94492 0.96839 0.00758 0.00256
CLIMB              1.18858 1.21811 0.00954 0.00323 0.00014      0.94492 0.96839 0.00758 0.00256 0.00011
DESCENT            0.85902 1.71804 0.01510 0.00541 0.00010      0.49537 0.99074 0.00871 0.00312 0.00006
DESCENT   ON       1.20403 1.14937 0.02331 0.00433 0.00010      0.80469 0.76816 0.01558 0.00289 0.00006
APPROACH           1.07231 1.37157 0.01860 0.00147 0.00007      0.39318 0.50291 0.00682 0.00054 0.00002
TAXI               0.74185 1.88316 0.02099 0.00195 0.00006      0.06924 0.17576 0.00196 0.00018 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-038
                                                         ENGINE  4.PLANE  5


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199599-9-A
ENGINE TOTAL TIME:   8085 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        79.8    79.8                FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG     30.03   30.03                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0126 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY : 278%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW  F/A TEMP
                            IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              800         4.7   54 .087  291   7.2   7.1   6155    16  11
IDLE/TAXI            1200         7.2   87 .084  392   6.2   7.7   2495    32   7
RUN UP               1700        14.1  169 .084  661   6.4   7.8   2274   144
RUN UP-L.            1650        14.1  169 .083  673   6.5   8.1   1996   131
RUN UP-R.            1675        14.1  170 .083  684   6.3   8.1   1941   136
TAKE OFF        FULL 2700        44.8  504 .089 1143   8.8   7.5   2107   237
CLIMB           FULL 2700        44.8  504 .089 1143   8.8   7.5   2107   237
DESCENT         65 % 2400        38.3  450 .085  998   7.0   7.7   1664   178   4
DESCENT    ON   65 % 2400        36.4  374 .097  964  10.6   5.8   2606    59   4
APPROACH        40 % 1950        21.1  233 .090  830   8.4   6.6   2274    75   6
TAXI                 1200         5.6   67 .082  448   6.2   8.2   2052    97   9

EXHAUST EMISSION MASS DATA :

  TEST     CARB   ---------------- #/# FUEL ----------------   ---------------- #/ MIN ----------------
  MODE     HEAT
                     CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW          0.95739 1.48358 0.03984 0.00035 0.00016      0.07500 0.11621 0.00312 0.00003 0.00001
IDLE/TAXI         0.86905 1.69606 0.01702 0.00074 0.00011      0.10429 0.20353 0.00204 0.00009 0.00001
RUN UP            0.87981 1.68499 0.01522 0.00325              0.20675 0.39597 0.00358 0.00076
RUN UP-L.         0.87108 1.70579 0.01302 0.00288              0.20470 0.40086 0.00306 0.00068
RUN UP-R.         0.85617 1.72981 0.01284 0.00304              0.20120 0.40651 0.00302 0.00071
TAKE OFF          1.05709 1.41575 0.01232 0.00468              0.78930 1.05709 0.00920 0.00349
CLIMB             1.05709 1.41575 0.01232 0.00468              0.78930 1.05709 0.00920 0.00349
DESCENT           0.93387 1.61427 0.01081 0.00390 0.00006      0.59612 1.03044 0.00690 0.00249 0.00004
DESCENT    ON     1.26186 1.08499 0.01510 0.00115 0.00005      0.76553 0.65823 0.00916 0.00070 0.00003
APPROACH          1.09408 1.35085 0.01442 0.00164 0.00008      0.38475 0.47505 0.00507 0.00056 0.00003
TAXI              0.84194 1.74983 0.01356 0.00216 0.00013      0.07858 0.16332 0.00127 0.00020 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-039
                                                           ENGINE  4.PLANE  5



ENGINE TYPE AND MODEL: 0-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199599-9-A
ENGINE TOTAL TIME:   0000 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        78.0    79.9              FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG    30.03   30.03              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0118 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  56%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW             800       4.7   58 .081  247  4.8  7.9  4575   22  13
IDLE/TAXI           1200       7.2   91 .080  381  4.9  8.4  2422   71  10
RUN UP              1700      13.2  167 .079  673  5.0  8.6  1930  292
RUN UP-L.           1650      13.2  165 .080  639  5.1  8.3  2045  120
RUN UP-R.           1675      13.2  170 .078  684  4.4  8.8  1561  302
TAKE OFF       FULL 2650      31.8  465 .068 1300  1.1 11.3   382 1517
CLIMB          FULL 2650      31.8  465 .068 1300  1.1 11.3   382 1517   3
DESCENT        65 % 2400      26.4  367 .072 1110  2.5 10.1   694  913
DESCENT    ON  65 % 2338      37.4  395 .097  986 10.3  5.8  2697   82   2
APPROACH       40 % 1950      17.6  209 .084  863  6.4  7.5  2045  111   6
TAXI                1200       6.4   78 .082  460  5.8  8.3  2153  123   6

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                               (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW        0.72354 1.87130 0.03357 0.00054 0.00021     0.05668 0.14659 0.00263 0.00004 0.00002
IDLE/TAXI       0.71763 1.93322 0.01727 0.00171 0.00016     0.08612 0.23199 0.00207 0.00020 0.00002
RUN UP          0.71949 1.94467 0.01282 0.00690             0.15829 0.42783 0.00282 0.00152
RUN UP-L.       0.74350 1.90145 0.01451 0.00287             0.16357 0.41832 0.00319 0.00063
RUN UP-R.       0.65338 2.05349 0.01128 0.00737             0.14374 0.45177 0.00248 0.00162
TAKE OFF        0.17540 2.83147 0.00297 0.03974             0.09296 1.50068 0.00157 0.02106
CLIMB           0.17540 2.83147 0.00297 0.03974 0.00005     0.09296 1.50068 0.00157 0.02106 0.00003
DESCENT         0.39136 2.48460 0.00529 0.02348             0.17220 1.09322 0.00233 0.01033
DESCENT   ON    1.24794 1.10428 0.01591 0.00163 0.00003     0.77788 0.68833 0.00992 0.00102 0.00002
APPROACH        0.89995 1.65727 0.01400 0.00256 0.00009     0.26399 0.48613 0.00411 0.00075 0.00003
TAXI            0.80357 1.80704 0.01452 0.00280 0.00009     0.08571 0.19275 0.00155 0.00030 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-414-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-042
                                                        ENGINE  4.PLANE  5


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199599-9-A
ENGINE TOTAL TIME:    0091 HRS.                        TSMOH:         HRS.
FUEL : 80 OCTANE

                             START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F         80.0    80.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.03   30.03             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0116 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  53*

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  *     %     PPMC   PPM PPM

IDLE-LOW              800         4.7   56 .084  280   6.0  7.7  6270    17   21
IDLE/TAXI            1200         7.2   88 .082  426   5.8  8.2  3428    76   13
RUN UP               1700        13.2  163 .081  751   6.0  8.8  2146   115
RUN UP-L.            1625        13.2  163 .081  684   5.7  8.3  2202    92
RUN UP-R.            1675        13.2  173 .076  785   4.2  9.7  1644   170
TAKE OFF        FULL 2650        49.6  546 .091 1188   9.6  7.4  2202   124
CLIMB           FULL 2650        49.6  546 .091 1188   9.6  7.4  2202   124    7
DESCENT         65 * 2400        32.8  380 .086 1099   7.8  7.8  1756   122    6
DESCENT    ON   65 * 2400        37.4  381 .098 1031  11.3  6.0  2592    43   19
APPROACH        40 * 1950        22.0  239 .092  908   9.2  6.6  2369    58   11
TAXI                 1200         6.4   76 .085  584   7.2  8.2  2815    63    9

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW         0.83060 1.67504 0.04225 0.00039 0.00031      0.06506 0.13121 0.00331 0.00003 0.00002
IDLE/TAXI        0.80243 1.78185 0.02307 0.00173 0.00019      0.09624 0.21382 0.00277 0.00021 0.00002
RUN UP           0.79256 1.82667 0.01380 0.00250              0.17436 0.40187 0.00304 0.00055
RUN UP-L.        0.79500 1.81913 0.01495 0.00211              0.17490 0.40021 0.00329 0.00046
RUN UP-R.        0.59228 2.14952 0.01129 0.00394              0.13030 0.47289 0.00248 0.00087
TAKE OFF         1.10568 1.33932 0.01235 0.00235              0.91403 1.10717 0.01021 0.00194
CLIMB            1.10568 1.33932 0.01235 0.00235 0.00009      0.91403 1.10717 0.01021 0.00194 0.00007
DESCENT          0.98063 1.54099 0.01075 0.00252 0.00008      0.53608 0.84241 0.00587 0.00138 0.00004
DESCENT    ON    1.27635 1.06497 0.01425 0.00080 0.00023      0.79559 0.66381 0.00888 0.00050 0.00014
APPROACH         1.13779 1.28267 0.01426 0.00118 0.00015      0.41719 0.47031 0.00523 0.00043 0.00005
TAXI             0.91063 1.62973 0.01733 0.00131 0.00012      0.09713 0.17384 0.00185 0.00014 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-041
                                                           ENGINE  4.PLANE  6


ENGINE TYPE AND MODEL: O-200-A                 ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199196-9-A
ENGINE TOTAL TIME:   9521 HRS.                        TSMOH:         HRS.
FUEL : 90 OCTANE

                            START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F        84.0    86.5            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.97   29.97            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0131 # H20/# DRY AIR          TEST START : COLD
RELATIVE HUMIDITY :  50%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN  FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE     HEAT             PRES FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW                800       4.7   47 .101  325  7.2  5.3 13559    4   5
IDLE/TAXI              1200       8.1   87 .093  426  7.5  5.3  4076   17  13
RUN UP                 1700      13.2  162 .082  695  5.0  7.1  2089  153
RUN UP-L.              1600      14.1  174 .081  661  4.6  7.1  2083   87
RUN UP-R.              1675      14.1  173 .081  706  4.9  7.2  2024  130
TAKE OFF          FULL 2600      49.6  526 .094 1087  9.0  5.8  2634  122
CLIMB             FULL 2600      49.6  526 .094 1087  9.0  5.8  2634  122   8
DESCENT           65 % 2400      33.7  420 .083 1031  5.4  7.2  1747  305   7
DESCENT     ON    65 % 2325      40.1  413 .097 1009  9.5  5.3  3632  137   7
APPROACH          40 % 1950      21.1  233 .090  852  7.4  5.9  2412   89   6
TAXI                   1200       6.4   70 .091  460  7.7  6.0  3189   42   9

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                      CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW           1.03061 1.19215 0.09448 0.00009 0.00008     0.08073 0.09339 0.00740 0.00001 0.00001
IDLE/TAXI          1.12625 1.25067 0.02900 0.00042 0.00021     0.15204 0.16884 0.00402 0.00006 0.00003
RUN UP             0.83571 1.79788 0.01632 0.00405             0.17726 0.39553 0.00359 0.00089
RUN UP-L.          0.76615 1.85827 0.01686 0.00238             0.18045 0.43669 0.00396 0.00056
RUN UP-R.          0.79095 1.82403 0.01589 0.00344             0.18564 0.42465 0.00373 0.00081
TAKE OFF           1.18499 1.20004 0.01688 0.00264             0.97959 0.99203 0.01396 0.00218
CLIMB              1.18499 1.20004 0.01688 0.00264 0.00011     0.97959 0.99203 0.01396 0.00218 0.00009
DESCENT            0.83838 1.75660 0.01320 0.00778 0.00012     0.47089 0.98662 0.00742 0.00437 0.00007
DESCENT     ON     1.24259 1.08937 0.02313 0.00294 0.00010     0.83047 0.72845 0.01546 0.00197 0.00007
APPROACH           1.03385 1.35795 0.01720 0.00214 0.00009     0.38115 0.47755 0.00605 0.00075 0.00003
TAXI               1.08936 1.33391 0.02196 0.00098 0.00014     0.11629 0.14228 0.00234 0.00010 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-042
                                                           ENGINE  4.PLANE  6


ENGINE TYPE AND MODEL: O-200-A                   ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199196-8-A
ENGINE TOTAL TIME:   9524 HRS.                         TSMOH:         HRS.
FUEL : 90 OCTANE

                             START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F         86.5    88.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.97   29.97                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0132 # H20/# DRY AIR               TEST START : HOT
RELATIVE HUMIDITY :  48%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR        DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              800          2.2   25 .089  291  6.2   6.2  9553    24  20
IDLE/TAXI            1200          6.4   73 .088  404  6.7   6.4  3239    47  11
RUN UP               1700         13.2  170 .078  684  3.9   7.9  1976   429
RUN UP-L.            1625         13.2  168 .079  650  4.1   7.5  1921   150
RUN UP-R.            1675         12.4  165 .075  695  3.0   8.5  1537   424
TAKE OFF        FULL 2600         49.6  522 .095 1087  9.2   5.7  2525   122
CLIMB           FULL 2600         49.6  522 .095 1087  9.2   5.7  2525   122  22
DESCENT         65 % 2400         31.8  387 .082 1043  5.4   7.4  1537   327  23
DESCENT    ON   65 % 2325         41.1  420 .098 1043  9.6   5.3  7302   229  26
APPROACH        40 % 1950         21.1  234 .090  863  7.4   6.0  2306    82   8
TAXI                 1200          4.7   53 .089  437  7.1   6.1  2635    43


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.92073 1.44687 0.06906 0.00059 0.00032     0.03376 0.05305 0.00253 0.00002 0.00001
IDLE/TAXI        0.98990 1.48591 0.02330 0.00114 0.00017     0.10559 0.15454 0.00240 0.00012 0.00002
RUN UP           0.64471 2.05222 0.01590 0.01165             0.14184 0.45149 0.00350 0.00256
RUN UP-L.        0.68959 1.98226 0.01573 0.00414             0.15171 0.43610 0.00346 0.00091
RUN UP-R.        0.51057 2.27324 0.01273 0.01185             0.10552 0.46980 0.00263 0.00245
TAKE OFF         1.20420 1.17241 0.01609 0.00262             0.99547 0.96920 0.01330 0.00217
CLIMB            1.20420 1.17241 0.01609 0.00262 0.00031     0.99547 0.96920 0.01330 0.00217 0.00026
DESCENT          0.82679 1.78044 0.01146 0.00823 0.00038     0.43920 0.94364 0.00607 0.00436 0.00020
DESCENT    ON    1.21815 1.05682 0.04510 0.00477 0.00035     0.83444 0.72392 0.03090 0.00327 0.00024
APPROACH         1.07674 1.37191 0.01633 0.00196 0.00012     0.37865 0.48246 0.00574 0.00069 0.00004
TAXI             1.04591 1.41289 0.01898 0.00104             0.08193 0.11061 0.00148 0.00008
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-043
                                                            ENGINE  4.PLANE  6


ENGINE TYPE AND MODEL : O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 199196-8-A
ENGINE TOTAL TIME:   9537 HRS.                        TSMOH:          HRS.
FUEL : 80 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        88.5    88.5              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.96   29.96              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0133 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  46%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               800        3.0   37 .043  280  5.6   7.9   7576    31  29
IDLE/TAXI             1200        5.6   66 .084  392  6.9   8.2   3074    63   9
RUN UP                1702       13.2  172 .077  740  4.6  10.3   2416   392
RUN UP-L.             1625       12.4  157 .079  717  5.1   9.4   2361   134
RUN UP-R.             1675       12.4  166 .074  740  3.6  10.7   2086   560
TAKE OFF         FULL 2600       48.6  541 .090 1199  9.4   7.6   2580   210
CLIMB            FULL 2600       48.6  541 .090 1199  9.4   7.6   2580   210  11
DESCENT          65 % 2400       31.8  382 .083 1121  7.0   8.6   2031   244  10
DESCENT     ON   65 % 2325       39.2  390 .101 1043 12.2   5.8   4392    71  13
APPROACH         40 % 1950       19.3  214 .090  908  9.1   7.3   3019    91  10
TAXI                  1200        5.6   64 .087  482  8.2   7.7   3294    60   8

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ----------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                           (NO2)    (HCHO)                               (NO2)    (HCHO)

IDLE-LOW        0.77900 1.72692 0.05130 0.00071 0.00043    0.03895 0.08635 0.00257 0.00004 0.00002
IDLE/TAXI       0.88821 1.65873 0.01926 0.00133 0.00012    0.08290 0.15481 0.00180 0.00012 0.00001
RUN UP          0.60253 2.12010 0.01540 0.00844            0.13256 0.46642 0.00339 0.00186
RUN UP-L.       0.68641 1.98809 0.01547 0.00296            0.14186 0.41087 0.00320 0.00061
RUN UP-R.       0.49212 2.29852 0.01398 0.01258            0.10171 0.47503 0.00287 0.00260
TAKE OFF        1.08027 1.37250 0.01443 0.00396            0.87502 1.11173 0.01169 0.00321
CLIMB           1.08027 1.37250 0.01443 0.00396 0.00014    0.87502 1.11173 0.01169 0.00321 0.00011
DESCENT         0.87852 1.69608 0.01241 0.00503 0.00013    0.46562 0.89892 0.00658 0.00267 0.00007
DESCENT   ON    1.31224 0.98034 0.02300 0.00125 0.00015    0.85733 0.64049 0.01502 0.00082 0.00010
APPROACH        1.08062 1.36222 0.01745 0.00178 0.00013    0.34760 0.43818 0.00561 0.00057 0.00004
TAXI            1.00209 1.47470 0.01960 0.00120 0.00010    0.09353 0.13841 0.00183 0.00011 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-044
                                                           ENGINE  4.PLANE  7


ENGINE TYPE AND MODEL: O-200-A                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204579
ENGINE TOTAL TIME:   7141 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        90.5    87.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.85   29.85               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0148 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  50%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %     %    PPMC   PPM PPM

IDLE-LOW              800         2.2   25 .088  325  8.2   7.5   7570    22  25
IDLE/TAXI            1200         7.2   82 .088  426  8.3   7.4   3355    49  20
RUN UP               1700        19.3  231 .083  673  6.7   8.3   2468   190
RUN UP-L.            1625        15.8  190 .083  650  6.5   8.2   2523   114
RUN UP-R.            1650        16.7  200 .084  695  6.8   8.3   2135   125
TAKE OFF        FULL 2600        49.6  519 .096 1076 11.0   6.6   2911    94
CLIMB           FULL 2600        49.6  519 .096 1076 11.0   6.6   2911    94  11
DESCENT         65 % 2400        34.6  416 .083 1054  6.8   8.5   1802   311  10
DESCENT    ON   65 % 2300        39.2  416 .094 1031 10.4   6.7   3022   173  13
APPROACH        40 % 1950        21.1  232 .091  841  9.1   7.0   2690   125  15
TAXI                 1200         7.2   84 .087  437  8.2   8.1   3022    75  13

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                     CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW           0.98823 1.42037 0.04441 0.00044 0.00032     0.03624 0.05208 0.00163 0.00002 0.00001
IDLE/TAXI          1.02658 1.43027 0.02020 0.00100 0.00027     0.12319 0.17259 0.00242 0.00012 0.00003
RUN UP             0.87155 1.69664 0.01563 0.00406             0.28035 0.54575 0.00503 0.00131
RUN UP-L.          0.86219 1.70921 0.01529 0.00248             0.22704 0.45009 0.00429 0.00065
RUN UP-R.          0.88070 1.68925 0.01346 0.00266             0.24513 0.47017 0.00375 0.00074
TAKE OFF           1.21941 1.14973 0.01571 0.00171             1.00805 0.95045 0.01299 0.00142
CLIMB              1.21941 1.14973 0.01571 0.00171 0.00013     1.00805 0.95045 0.01299 0.00142 0.00011
DESCENT            0.87122 1.71133 0.01124 0.00655 0.00014     0.50240 0.98686 0.00648 0.00377 0.00008
DESCENT    ON      1.18529 1.19994 0.01677 0.00324 0.00016     0.77439 0.78396 0.01095 0.00212 0.00010
APPROACH           1.10259 1.33280 0.01587 0.00249 0.00019     0.38774 0.46870 0.00558 0.00088 0.00007
TAXI               0.97959 1.52058 0.01757 0.00147 0.00017     0.11755 0.18247 0.00211 0.00018 0.00002
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SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-045
ENGINE 4.PLANE 7

ENGINE TYPE AND MODEL: O-200-A ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204579
ENGINE TOTAL TIME: 7144 HRS. TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	89.0	89.5
ATMOSPHERIC PRES.-IN.HG	29.86	29.86

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0149 # H20/# DRY AIR
RELATIVE HUMIDITY : 50%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		5.6	64	.085	303	7.4	7.8	6313	40	23
IDLE/TAXI			1200		8.1	94	.086	437	7.6	8.1	3184	82	14
RUN UP			1700		15.0	187	.080	684	5.5	9.1	2416	273	
RUN UP-L.			1625		15.0	183	.082	650	6.0	8.4	2525	133	
RUN UP-R.			1675		14.1	182	.078	695	4.8	9.8	1976	278	
TAKE OFF		FULL	2600		49.6	515	.096	1076	11.2	6.5	2965	89	
CLIMB		FULL	2600		49.6	515	.096	1076	11.2	6.5	2965	89	11
DESCENT		65 %	2400		34.6	414	.083	1054	6.9	8.5	1976	342	10
DESCENT	ON	65 %	2325		41.1	430	.096	1043	11.0	6.6	3294	199	11
APPROACH		40 %	1950		21.1	231	.091	830	9.3	7.0	2965	129	9
TAXI			1200		7.2	83	.087	493	8.2	8.0	3074	83	12

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.92707	1.53557	0.03850	0.00082	0.00031	0.08653	0.14332	0.00359	0.00008	0.00003
IDLE/TAXI		0.94100	1.57600	0.01919	0.00167	0.00019	0.12704	0.21276	0.00259	0.00023	0.00003
RUN UP		0.73498	1.91096	0.01572	0.00599		0.18375	0.47774	0.00393	0.00150	
RUN UP-L.		0.81215	1.78673	0.01664	0.00407		0.20304	0.44668	0.00416	0.00102	
RUN UP-R.		0.64335	2.06407	0.01289	0.00612		0.15119	0.48506	0.00303	0.00144	
TAKE OFF		1.23431	1.12568	0.01591	0.00161		1.02037	0.93056	0.01315	0.00133	
CLIMB		1.23431	1.12568	0.01591	0.00161	0.00013	1.02037	0.93056	0.01315	0.00133	0.00011
DESCENT		0.87738	1.69845	0.01223	0.00714	0.00014	0.50595	0.97944	0.00705	0.00412	0.00008
DESCENT	ON	1.21681	1.14728	0.01774	0.00362	0.00013	0.83351	0.78589	0.01215	0.00248	0.00009
APPROACH		1.11138	1.31453	0.01725	0.00253	0.00012	0.39083	0.46228	0.00607	0.00089	0.00004
TAXI		0.98521	1.51043	0.01798	0.00164	0.00015	0.11823	0.18125	0.00216	0.00020	0.00002

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-046
                                                          ENGINE  4.PLANE  7


ENGINE TYPE AND MODEL: O-200-A                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 204579
ENGINE TOTAL TIME:   7147 HRS.                           TSMOH:         HRS.
FUEL : 80 OCTANE

                             START  FINISH                SAMPLE LINE :
INLET AIR TEMP.-DEG.F         89.5    89.0                  FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG      29.86   29.86                  TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0149 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  50%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC   NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %    %     PPMC  PPM PPM

IDLE-LOW            800         3.0   36 .085  314  6.7  8.0  9717   32  30
IDLE/TAXI          1200         6.4   73 .088  426  8.4  7.8  4447   63  17
RUN UP             1700        13.2  165 .080  740  6.0  9.4  2525  370
RUN UP-L.          1650        13.2  162 .082  673  6.3  9.0  2745  172
RUN UP-R.          1675        13.2  171 .077  751  4.7 10.1  2196  341
TAKE OFF       FULL 2600       48.6  542 .090 1188  9.5  7.7  2473  137
CLIMB          FULL 2600       48.6  542 .090 1188  9.5  7.7  2473  137   9
DESCENT        65 % 2400       34.6  405 .085 1143  7.8  8.3  2306  254   6
DESCENT    ON  65 % 2325       41.1  414 .099 1065 12.0  6.1  4063   99   9
APPROACH       40 % 1950       22.0  237 .093  942 10.1  7.0  3184  103  11
TAXI                1200        5.6   61 .091  538  9.7  7.4  4831   54   9

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX     ALD           CO      CO2      THC      NOX     ALD
                                             (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW         0.84792 1.59098 0.05986 0.00067 0.00041       0.04240 0.07955 0.00299 0.00003 0.00002
IDLE/TAXI        1.00492 1.46053 0.02579 0.00123 0.00022       0.10676 0.15579 0.00275 0.00013 0.00002
RUN UP           0.76026 1.87169 0.01557 0.00770               0.16726 0.41177 0.00343 0.00169
RUN UP-L.        0.80227 1.80102 0.01702 0.00360               0.17650 0.39622 0.00374 0.00079
RUN UP-R.        0.62053 2.09582 0.01412 0.00740               0.13654 0.46108 0.00311 0.00163
TAKE OFF         1.07994 1.37550 0.01367 0.00256               0.87475 1.11415 0.01107 0.00207
CLIMB            1.07994 1.37550 0.01367 0.00256 0.00011       0.87475 1.11415 0.01107 0.00207 0.00009
DESCENT          0.94730 1.59404 0.01363 0.00507 0.00008       0.54628 0.91346 0.00786 0.00292 0.00005
DESCENT   ON     1.28605 1.02731 0.02120 0.00174 0.00010       0.88094 0.70371 0.01452 0.00119 0.00007
APPROACH         1.15003 1.25251 0.01765 0.00193 0.00013       0.42168 0.45925 0.00647 0.00071 0.00005
TAXI             1.09414 1.31168 0.02653 0.00100 0.00011       0.10212 0.12242 0.00248 0.00009 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-047
                                                         ENGINE  1.PLANE  5


ENGINE TYPE AND MODEL : O-320-E2D               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-28592-27A
ENGINE TOTAL TIME:   1010 HRS.                          TSMOH:         HRS.
FUEL : 80 OCTANE

                           START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       86.0    87.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.04   30.04               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0110 # H20/# DRY AIR         TEST START : COLD
RELATIVE HUMIDITY :  44%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW              800       7.2   83 .087  448  7.7  7.8  6180   13  20
IDLE/TAXI            1000       9.8  106 .092  460  9.4  6.7  4800   13  12
RUN UP               1700      25.5  310 .082  830  6.8  9.1  2152  158
RUN UP-L.            1625      26.4  324 .081  740  6.4  9.1  2152  144
RUN UP-R.            1625      25.5  314 .081  897  6.5  9.3  1986  140
TAKE OFF        FULL 2400      61.3  786 .087 1368  8.1  7.9  2152
CLIMB           FULL 2400      60.3  756 .080 1457  6.2 10.0  1655  182   6
DESCENT         65 % 2000      34.6  431 .080 1155  6.2  9.6  1710  157   4
DESCENT   ON    65 % 1950      40.1  475 .085 1155  7.6  8.6  2042  152   5
APPROACH        40 % 1500      15.8  199 .080  818  5.7  9.6  2042  163   7
TAXI                 1000       7.2   92 .079  560  5.2  9.5  2428   51   9

EXHAUST EMISSION MASS DATA :

  TEST   CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE   HEAT
                  CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                           (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW        0.94749 1.50825 0.03702 0.00026 0.00026     0.11370 0.18099 0.00444 0.00003 0.00003
IDLE/TAXI       1.12445 1.25945 0.02795 0.00025 0.00015     0.18366 0.20571 0.00457 0.00004 0.00003
RUN UP          0.83689 1.75993 0.01289 0.00319             0.35563 0.74797 0.00548 0.00136
RUN UP-L.       0.80771 1.80473 0.01322 0.00224             0.35539 0.79403 0.00582 0.00099
RUN UP-R.       0.80580 1.81172 0.01198 0.00204             0.34246 0.76998 0.00509 0.00087
TAKE OFF        0.99074 1.51043 0.01291                     1.01220 1.55133 0.01309
CLIMB           0.75138 1.90441 0.00976 0.00362 0.00008     0.75513 1.91393 0.00981 0.00364 0.00008
DESCENT         0.76994 1.87340 0.01034 0.00320 0.00005     0.44400 1.08032 0.00596 0.00185 0.00003
DESCENT   ON    0.91897 1.63393 0.01202 0.00302 0.00006     0.61411 1.09201 0.00803 0.00202 0.00004
APPROACH        0.72916 1.92980 0.01272 0.00343 0.00010     0.19231 0.50818 0.00335 0.00090 0.00003
TAXI            0.69019 1.98144 0.01569 0.00111 0.00013     0.08282 0.23777 0.00189 0.00013 0.00002
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-050
                                                     ENGINE  S.PLANE  1


ENGINE TYPE AND MODEL: IO-470-V              ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 170412-7-V-R
ENGINE TOTAL TIME:   9710 HRS.                    TSMOH:          HRS.
FUEL : 100 OCTANE

                          START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F      85.0    85.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.23   30.23             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0121 # H20/# DRY AIR         TEST START : COLD
RELATIVE HUMIDITY :  47%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH   CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW            700  15  25.2  270 .093  392  2.6  4.2 12100    5  54
IDLE/TAXI          1000  15  29.3  316 .093  852  6.5  7.0 16806   21  50
RUN UP             1700  19  41.0  464 .088 1199  9.1  8.1  5210   82
RUN UP-L.          1553  19  41.0  479 .086 1256  7.9  8.5  5042   63
RUN UP-R.          1600  19  41.0  475 .086 1256  8.2  8.4  5042   63
TAKE OFF       FULL 2600  28 111.3 1333 .084 1469  7.5  9.4  6850  163
CLIMB          75 % 2450  25  80.9  977 .083 1446  7.0  9.1  3193  166  29
DESCENT        65 % 2300  24  76.2  898 .085 1368  7.8  8.7  3529  122  13
APPROACH       40 % 2100  22  63.3  734 .086 1323  8.3  8.5  3809  133  10
TAXI               1000  16  29.3  309 .095  673  5.0  6.0 15798   41  36


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW        0.64378 1.63421 0.14584 0.00020 0.00143     0.27039 0.68637 0.06125 0.00009 0.00060
IDLE/TAXI       0.80571 1.52122 0.10153 0.00043 0.00066     0.39394 0.74285 0.04958 0.00021 0.00032
RUN UP          1.01847 1.42459 0.02838 0.00151             0.69596 0.97345 0.01940 0.00103
RUN UP-L.       0.92689 1.56716 0.02880 0.00121             0.63337 1.07090 0.01968 0.00083
RUN UP-R.       0.95084 1.53052 0.02846 0.00120             0.64974 1.04592 0.01945 0.00082
TAKE OFF        0.84976 1.67362 0.03337 0.00303             1.57630 3.10456 0.06190 0.00563
CLIMB           0.84555 1.72734 0.01877 0.00329 0.00038     1.14045 2.32903 0.02531 0.00444 0.00051
DESCENT         0.91794 1.60892 0.02022 0.00236 0.00016     1.16579 2.04333 0.02568 0.00300 0.00021
APPROACH        0.95814 1.54193 0.02140 0.00252 0.00012     1.01084 1.62673 0.02258 0.00266 0.00013
TAXI            0.78830 1.48651 0.12124 0.00106 0.00061     0.38495 0.72591 0.05921 0.00052 0.00030
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-051
                                                        ENGINE  S.PLANE  1



ENGINE TYPE AND MODEL: IO-470-V              ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 170012-7-V-R
ENGINE TOTAL TIME:   9710 HRS.                        TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        94.0    94.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.23   30.23              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0115 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  34%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW            700  15   24.0  227 .106  404  2.4   4.2 23956     0  37
IDLE/TAXI          1000  15   29.3  336 .087  841  5.4   7.7 10647     4  33
RUN UP             1700  18   42.0  491 .087 1188  8.7   8.4  4658    62
RUN UP-L.          1600  19   41.0  481 .085 1199  7.6   8.2  2995    42
RUN UP-R.          1695  19   41.6  489 .085 1199  7.3   8.0  3327    45
TAKE OFF      FULL 2590  28  116.0 1374 .084 1435  7.8   9.1  4714   115
CLIMB         75 % 2450  25   87.9 1077 .082 1457  6.8   9.6  2884    87  11
DESCENT       65 % 2300  24   75.0  884 .085 1390  7.9   8.8  3272    72  21
APPROACH      40 % 2100  22   63.3  713 .089 1300  9.3   8.0  3882    49   8
TAXI               1000  16   29.3  277 .106  729  6.6   5.9 26518    17  30


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW         0.52915 1.45516 0.25711 0.00000 0.00087     0.21166 0.58206 0.10294 0.00000 0.00035
IDLE/TAXI        0.75610 1.69424 0.07257 0.00009 0.00050     0.36923 0.82735 0.03544 0.00004 0.00024
RUN UP           0.99231 1.49040 0.02560 0.00115             0.70071 1.06315 0.01826 0.00082
RUN UP-L.        0.93626 1.58742 0.01796 0.00095             0.63978 1.08474 0.01227 0.00058
RUN UP-R.        0.92616 1.59495 0.02355 0.00094             0.64214 1.10583 0.01425 0.00065
TAKE OFF         0.89054 1.63266 0.02620 0.00216             1.72172 3.15648 0.05065 0.00417
CLIMB            0.80815 1.79286 0.01668 0.00170 0.00014     1.18393 2.62654 0.02444 0.00249 0.00021
DESCENT          0.92019 1.61076 0.01955 0.00138 0.00026     1.15024 2.01345 0.02319 0.00172 0.00033
APPROACH         1.04279 1.40960 0.02119 0.00090 0.00010     1.10014 1.48713 0.02235 0.00095 0.00010
TAXI             0.86335 1.21281 0.16950 0.00037 0.00053     0.42160 0.59225 0.08277 0.00018 0.00026
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-052
                                                        ENGINE  5.PLANE  1


ENGINE TYPE AND MODEL: IO-470-V                ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 170012-7-V-R
ENGINE TOTAL TIME:    971.0 HRS.                        TSMOH:         HRS.
FUEL : 100 OCTANE

                               START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F          96.0    96.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.14   30.14             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0111 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  31%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL  AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW             725  16  24.0  263 .091  740  4.8  7.8 19880   30  54
IDLE/TAXI           1000  16  29.3  311 .094  919  6.8  7.5 17551   44  40
RUN UP              1700  18  42.2  457 .092 1132 10.0  7.1  6738   38
RUN UP-L.           1600  18  41.6  460 .090 1256  9.3  7.5  6571   38
RUN UP-R.           1600  19  41.6  467 .089 1222  8.9  7.7  6072   33
TAKE OFF       FULL 2580  28 113.1 1300 .086       8.3  8.6  8235   76
CLIMB          75 % 2450  24  83.8 1001 .084       7.1  8.9  5906   53  10
DESCENT        65 % 2300  23  74.4  868 .086       7.9  8.5  5684   44   6
APPROACH       40 % 2100  21  58.6  669 .088       8.2  7.6  3300   62
TAXI                1000  15  29.3  308 .095       6.1  6.5 15888   44  33

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                  (NO2)    (HCHO)

IDLE-LOW          0.65259 1.66644 0.13157 0.00067 0.00079      0.26104 0.66658 0.05263 0.00027 0.00031
IDLE/TAXI         0.84002 1.45592 0.10554 0.00089 0.00064      0.41021 0.71098 0.05154 0.00044 0.00031
RUN UP            1.11587 1.24500 0.03660 0.00070              0.78483 0.87565 0.02574 0.00049
RUN UP-L.         1.05659 1.33900 0.03634 0.00071              0.73257 0.92837 0.02520 0.00049
RUN UP-R.         1.02593 1.39467 0.03407 0.00062              0.71124 0.96697 0.02362 0.00043
TAKE OFF          0.92880 1.51230 0.04486 0.00140              1.75080 2.85069 0.08456 0.00253
CLIMB             0.84877 1.67193 0.03437 0.00104 0.00013      1.18545 2.33513 0.04800 0.00145 0.00018
DESCENT           0.92338 1.56124 0.03234 0.00084 0.00008      1.14500 1.93593 0.04010 0.00105 0.00009
APPROACH          1.03827 1.46849 0.01975 0.00125              0.98474 1.43422 0.01929 0.00122
TAXI              0.85267 1.42777 0.10811 0.00101 0.00049      0.41639 0.69723 0.05279 0.00049 0.00024
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SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-053
ENGINE 0.PLANE 1

ENGINE TYPE AND MODEL: IO-360-C ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : F/51634-70C
ENGINE TOTAL TIME: 1690 HRS. TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	90.0	88.0
ATMOSPHERIC PRES.-IN.HG	30.14	30.14

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0140 # H20/# DRY AIR
RELATIVE HUMIDITY : 51%

TEST START : COLD

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800	17	16.4	144	.114	448	3.9	5.3	38264	11	51
IDLE/TAXI			1000	17	22.3	210	.106	471	3.4	5.9	33605	20	
RUN UP			1700	18	23.4	271	.086	852	7.7	8.1	7819	134	
RUN UP-L.			1600	18	19.9	233	.086	740	6.6	7.6	8152	78	
RUN UP-R.			1600	18	22.3	262	.085	874	6.9	8.1	7819	98	
TAKE OFF		FULL	2700	25	109.0	1240	.088	1222	8.5	8.0	6488		
CLIMB		75 %	2600	24	73.8	839	.088	1323	8.9	8.1	2939	228	18
DESCENT		65 %	2400	22	56.3	630	.089	1256	9.4	7.8	2884	209	16
APPROACH		40 %	2200	19	41.0	456	.090	1143	9.6	7.7	4159	209	13
TAXI			1000	16	23.4	180	.130	460	3.1	4.7	50907	14	24

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	---- #/# FUEL ----					---- #/ MIN ----				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.59379	1.26807	0.28360	0.00028	0.00083	0.16230	0.34660	0.07752	0.00008	0.00023
IDLE/TAXI		0.53263	1.45242	0.25626	0.00051		0.19796	0.53982	0.09524	0.00019	
RUN UP		0.92098	1.52244	0.04553	0.00263		0.35918	0.59375	0.01775	0.00103	
RUN UP-L.		0.87178	1.57751	0.05242	0.00169		0.28914	0.52321	0.01738	0.00056	
RUN UP-R.		0.86713	1.59962	0.04783	0.00202		0.32224	0.59452	0.01778	0.00075	
TAKE OFF		0.98306	1.45394	0.03653			1.78590	2.64133	0.06636		
CLIMB		1.02469	1.45976	0.01641	0.00430	0.00022	1.25545	1.79551	0.02018	0.00528	0.00027
DESCENT		1.06604	1.39006	0.01592	0.00389	0.00019	1.00030	1.30434	0.01494	0.00365	0.00018
APPROACH		1.07474	1.35462	0.02267	0.00384	0.00016	0.73441	0.92566	0.01549	0.00263	0.00011
TAXI		0.47696	1.13635	0.38127	0.00035	0.00040	0.18601	0.44318	0.14870	0.00014	0.00015

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-054
                                                       ENGINE  0.PLANE  1


ENGINE TYPE AND MODEL: IO-360-C               ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : F/51634-72C
ENGINE TOTAL TIME:    1694 HRS.                       TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F        88.0    88.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.13   30.13             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0146 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  52%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH   CO  CO2   THC   NO  ALD
  MODE    HEAT            PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR     DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW              600  18   18.8  102 .184  269  3.9  3.0 76527    5  10
IDLE/TAXI            1000  18   22.3  150 .149  348  3.7  4.3 65714   14  31
RUN UP               1700  18   24.6  302 .081  740  5.6  8.7  6655   94
RUN UP-L.            1600  18   19.9  242 .082  650  6.8  9.4  7431  167
RUN UP-R.            1600  18   22.3  270 .083  785  6.5  9.1  6987  137
TAKE OFF        FULL 2800  27  106.7 1234 .086 1244  8.3  8.4  4436  238
CLIMB           75 % 2600  24   78.5  904 .087 1334  8.6  8.4  2939  233  14
DESCENT         65 % 2400  22   59.8  669 .089 1233  9.5  7.9  3105  184   7
APPROACH        40 % 2200  19   38.7  424 .091 1099  9.9  7.5  6100  164  12
TAXI                 1000  16   24.6  186 .132  549  3.2  4.7 53569   14  21


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.53152 0.64249 0.50770 0.00011 0.00015     0.16654 0.20131 0.15908 0.00004 0.00005
IDLE/TAXI        0.50361 0.91972 0.43540 0.00031 0.00045     0.18718 0.34183 0.16182 0.00012 0.00017
RUN UP           0.74215 1.81183 0.04293 0.00194             0.30428 0.74285 0.01760 0.00079
RUN UP-L.        0.79600 1.72912 0.04234 0.00321             0.26401 0.57349 0.01404 0.00107
RUN UP-R.        0.79096 1.74012 0.04139 0.00274             0.29397 0.64674 0.01538 0.00102
TAKE OFF         0.96022 1.52710 0.02498 0.00452             1.70760 2.71569 0.04443 0.00804
CLIMB            0.98628 1.51383 0.01641 0.00439 0.00017     1.29039 1.98059 0.02147 0.00574 0.00023
DESCENT          1.06387 1.39023 0.01693 0.00339 0.00008     1.06032 1.38560 0.01687 0.00337 0.00008
APPROACH         1.09023 1.29789 0.03270 0.00297 0.00014     0.70320 0.83714 0.02109 0.00191 0.00009
TAXI             0.47874 1.10496 0.39013 0.00034 0.00034     0.19629 0.45303 0.15995 0.00014 0.00014
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-055
                                                          ENGINE  B.PLANE  1


ENGINE TYPE AND MODEL: IO-360-C                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : F/51634-70C
ENGINE TOTAL TIME:    1697 HRS.                           TSMOH:         HRS.
FUEL : 100 OCTANE

                              START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F          94.0    94.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.12   30.12                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0159 # H20/# DRY AIR                TEST START : HOT
RELATIVE HUMIDITY :  46%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F   %    %    PPMC   PPM PPM

IDLE-LOW             800  17   12.9  127 .101  381  3.5  6.6 32020   16  43
IDLE/TAXI           1000  17   16.4  166 .099  448  3.4  7.2 31937   33  45
RUN UP              1700  18   24.6  305 .081  773  5.9  9.2  3595  150
RUN UP-L.           1600  18   21.1  255 .083  729  6.8  8.9  4264  208
RUN UP-R.           1600  18   23.4  284 .082  807  6.9  9.1  3595
TAKE OFF       FULL 2800  27  109.0 1214 .090 1155  9.5  7.7  3651  170
CLIMB          75 % 2600  24   77.4  896 .086 1312  8.5  8.6  2703  243   6
DESCENT        65 % 2400  22   59.8  678 .088 1222  9.0  8.0  2815  243  13
APPROACH       40 % 2200  19   39.8  452 .088 1099  9.0  8.0  3316  243  13
TAXI                1000  16   18.8  170 .110  482  3.5  6.7 44645   19  19

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                           (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW        0.52185 1.54638 0.23240 0.00039 0.00069    0.11220 0.33247 0.04997 0.00008 0.00015
IDLE/TAXI       0.48887 1.62683 0.22354 0.00078 0.00069    0.13362 0.44467 0.06110 0.00021 0.00019
RUN UP          0.75692 1.85474 0.02245 0.00316            0.31034 0.76044 0.00920 0.00130
RUN UP-L.       0.83631 1.72006 0.02553 0.00420            0.29410 0.60449 0.00998 0.00148
RUN UP-R.       0.82946 1.74431 0.02135                    0.32349 0.68028 0.00833
TAKE OFF        1.07268 1.36625 0.02007 0.00315            1.94870 2.48202 0.03646 0.00573
CLIMB           0.97053 1.54306 0.01502 0.00456 0.00007    1.25198 1.99054 0.01938 0.00588 0.00009
DESCENT         1.03290 1.44278 0.01573 0.00383 0.00016    1.02945 1.43797 0.01567 0.00381 0.00016
APPROACH        1.02991 1.43861 0.01847 0.00382 0.00016    0.68317 0.95427 0.01225 0.00253 0.00011
TAXI            0.47337 1.42396 0.29393 0.00042 0.00028    0.14832 0.44617 0.09210 0.00013 0.00009
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-056
                                                         ENGINE  1.PLANE  6


ENGINE TYPE AND MODEL: O-320-E2A                  ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26231-27A
ENGINE TOTAL TIME:    1394 HRS.                        TSMOH:          HRS.
FUEL : 80 OCTANE


                             START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F         91.0    81.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.05   30.05            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0108 # H20/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  48%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL  AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F    %    %     PPMC   PPM PPM

IDLE-LOW              800              72 .081  303  2.7   4.2   1734    25  11
IDLE/TAXI            1000              64 .091  426  6.1   4.8   2889    27  15
RUN UP               1700        25.8 298 .087  874  8.5   8.4   2312   113
RUN UP-L.            1600        23.4 275 .085  785  7.8   8.4   2254    96
RUN UP-R.            1600        25.8 300 .086  942  8.2   8.4   1965    38
TAKE OFF        FULL 2375        64.5 734 .088 1211  9.2   8.4   2369   247
CLIMB           FULL 2375        66.8 761 .088 1211  9.2   8.4   2369   247   7
DESCENT         65 % 2000        29.3 358 .082 1143  6.9   9.5   1849   384   4
DESCENT    ON   65 % 2000        41.0 413 .099 1043 12.2   6.1   4797   132
APPROACH        40 % 1500             141 .083  852  7.3   8.9   1965   137  10
TAXI                 1000             443 .077  415  2.7   6.1    925    93  10

EXHAUST EMISSION MASS DATA :

  TEST   CARB   --------------- #/# FUEL ---------------      ---------------- #/ MIN ---------------
  MODE   HEAT
               CO       CO2      THC       NOX      ALD          CO       CO2       THC      NOX       ALD
                                          (NO2)    (HCHO)                                    (NO2)     (HCHO)

IDLE-LOW       0.75706 1.85060 0.02367 0.00115 0.00033
IDLE/TAXI      1.00128 1.33704 0.02493 0.00079 0.00028
RUN UP         0.98437 1.52821 0.01303 0.00215            0.42315 0.65713 0.00560 0.00092
RUN UP-L.      0.94183 1.59387 0.01325 0.00190            0.36732 0.62161 0.00517 0.00074
RUN UP-R.      0.96826 1.55866 0.01129 0.00171            0.41635 0.67022 0.00486 0.00073
TAKE OFF       1.02297 1.46774 0.01282 0.00451            1.09970 1.57782 0.01378 0.00485
CLIMB          1.02297 1.46774 0.01282 0.00451 0.00008    1.13891 1.63409 0.01428 0.00502 0.00009
DESCENT        0.82515 1.78526 0.01076 0.00754 0.00005    0.40295 0.87180 0.00526 0.00368 0.00003
DESCENT   ON   1.28845 1.01235 0.02466 0.00229            0.88044 0.69177 0.01685 0.00156
APPROACH       0.88301 1.69172 0.01157 0.00372 0.00013
TAXI           0.60219 2.13794 0.01004 0.00341 0.00024
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-057
                                                         ENGINE  1.PLANE  6



ENGINE TYPE AND MODEL: O-320-E2A             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26201-27A
ENGINE TOTAL TIME:   1394 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        81.0    81.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.05   30.05                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0108 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  48%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH   CO   CO2   THC   NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW            800         9.4  125 .075  291  2.1  6.4  1971   56   9
IDLE/TAXI          1000        11.7  143 .082  448  5.7  7.9  2196   93  10
RUN UP             1700        29.3  335 .088  897  8.7  8.1  2309  172
RUN UP-L.          1600        29.3  331 .088  841  9.0  7.9  2534  101
RUN UP-R.          1600        29.3  336 .087  919  8.9  8.3  2196  115
TAKE OFF      FULL 2350        64.5  725 .089 1233  9.3  7.9  2252
CLIMB         FULL 2350        64.5  725 .089 1233  9.3  7.9  2252       10
DESCENT       65 % 2000        41.0  495 .083 1143  7.2  9.2  1858        7
DESCENT   ON  65 % 2000        56.3  550 .102 1054 13.0  5.7  5237       12
APPROACH      43 % 1500        17.6  208 .084  874  7.7  8.8  2140       10
TAXI               1000        11.7  153 .077  448  3.6  8.1  1295        9

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                           (NO2)   (HCHO)                               (NO2)   (HCHO)

IDLE-LOW        0.47890 2.29348 0.02188 0.00210 0.00022    0.07503 0.35931 0.00343 0.00033 0.00003
IDLE/TAXI       0.81804 1.78165 0.01534 0.00219 0.00015    0.15952 0.34742 0.00299 0.00043 0.00003
RUN UP          1.01316 1.48231 0.01309 0.00329            0.49476 0.72386 0.00639 0.00161
RUN UP-L.       1.04061 1.43538 0.01426 0.00192            0.50816 0.70094 0.00696 0.00094
RUN UP-R.       1.01332 1.48501 0.01217 0.00215            0.49484 0.72518 0.00594 0.00105
TAKE OFF        1.05852 1.41299 0.01248                    1.13791 1.51897 0.01341
CLIMB           1.05852 1.41299 0.01248         0.00012    1.13791 1.51897 0.01341         0.00013
DESCENT         0.86098 1.72879 0.01092         0.00009    0.58833 1.18134 0.00739         0.00006
DESCENT   ON    1.34123 0.92412 0.02630         0.00013    1.25852 0.86713 0.02468         0.00012
APPROACH        0.91371 1.64094 0.01236         0.00013    0.26802 0.48134 0.00363         0.00004
TAXI            0.60358 2.13407 0.01857         0.00016    0.11770 0.41614 0.00206         0.00003
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-058
                                                         ENGINE  1.PLANE  6


ENGINE TYPE AND MODEL: O-320-E2A               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-26201-27A
ENGINE TOTAL TIME:   1394 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                             START  FINISH
INLET AIR TEMP.-DEG.F         84.5    84.5            SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG      30.05   30.05             FLOW RATE    7 LPM
                                                       TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0111 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  44%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB  PWR RPM  MAN  FUEL AIR  CALC EXH    CO   CO2    THC   NO  ALD
  MODE     HEAT           PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC  PPM PPM

IDLE-LOW               800       9.4  128 .073  314   1.7  6.5  1641         7
IDLE/TAXI             1000      10.5  135 .078  415   4.0  7.8  1415         6
RUN UP                1700      27.0  304 .089  942   8.4  7.3  2151
RUN UP-L.             1600      27.0  306 .088  874   8.3  7.5  2207
RUN UP-R.             1600      28.1  321 .088  986   8.2  7.6  1981
TAKE OFF          FULL 2300     66.8  746 .090 1222   9.1  7.5  2151
CLIMB             FULL 2300     66.8  746 .090 1222   9.1  7.5  2151         9
DESCENT           65 % 2000     37.5  453 .083 1143   6.9  8.8  1755         7
DESCENT     ON    65 % 2000     50.4  493 .102 1043  11.9  5.3  5037        10
APPROACH          40 % 1500     17.6  208 .084  852   7.0  8.0  1981         8
TAXI                  1000      10.5  139 .076  448   3.1  7.5  1075         9

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                           (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW        0.40311 2.42206 0.01894            0.00018    0.06315 0.37945 0.00297            0.00003
IDLE/TAXI       0.66435 2.03576 0.01144            0.00011    0.11626 0.35626 0.00200            0.00002
RUN UP          1.04680 1.42956 0.01305                       0.47106 0.64330 0.00587
RUN UP-L.       1.02752 1.45925 0.01330                       0.46239 0.65657 0.00599
RUN UP-R.       1.01658 1.48059 0.01196                       0.47610 0.69341 0.00560
TAKE OFF        1.07334 1.39012 0.01235                       1.19499 1.54767 0.01375
CLIMB           1.07334 1.39012 0.01235            0.00011    1.19499 1.54767 0.01375            0.00013
DESCENT         0.86242 1.72761 0.01067            0.00009    0.53876 1.07976 0.00667            0.00006
DESCENT    ON   1.33315 0.93304 0.02747            0.00012    1.11985 0.78376 0.02307            0.00010
APPROACH        0.91349 1.64056 0.01258            0.00011    0.26796 0.48123 0.00369            0.00003
TAXI            0.57421 2.18305 0.00969            0.00018    0.10049 0.38203 0.00170            0.00003
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-059
                                                          ENGINE  1.PLANE  7


ENGINE TYPE AND MODEL: O-320-E2A                  ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27474-27A
ENGINE TOTAL TIME:    1025 HRS.                            TSMOH:          HRS.
FUEL : 80 OCTANE

                              START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F          77.0    77.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       29.76   29.76               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0097 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  49%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              800        17.6  202 .087  325  3.3  3.4  1821          7
IDLE/TAXI            1000        23.4  257 .091  404  6.0  4.7  2269
RUN UP               1700        41.0  450 .091  964  9.8  7.5  3277
RUN UP-L.            1600        32.8  363 .090  897  9.6  7.6  2829
RUN UP-R.            1600        41.0  451 .091  998  9.8  7.5  2997
TAKE OFF        FULL 2200        73.8  785 .094 1199 11.1  7.1  3109
CLIMB           FULL 2200        73.8  785 .094 1199 11.1  7.1  3109          8
DESCENT         65 % 2000        51.6  569 .091 1155  9.8  7.6  2997          8
DESCENT    ON   65 % 2000        51.6  570 .090 1121  9.8  7.7  3109          7
APPROACH        40 % 1500        28.1  305 .092  897 10.2  7.3  4174          8
TAXI                 1000        19.9  243 .082  448  3.9  5.6  1597          6

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.95102 1.53974 0.02555          0.00022      0.27897 0.45166 0.00749            0.00006
IDLE/TAXI         1.08946 1.34058 0.02005                       0.42473 0.52282 0.00782
RUN UP            1.10262 1.32604 0.01795                       0.75345 0.90613 0.01226
RUN UP-L.         1.08946 1.35485 0.01562                       0.59536 0.74065 0.00854
RUN UP-R.         1.10437 1.32815 0.01644                       0.75466 0.90757 0.01123
TAKE OFF          1.18930 1.19542 0.01622                       1.46284 1.47037 0.01994
CLIMB             1.18930 1.19542 0.01622          0.00009      1.46284 1.47037 0.01994            0.00011
DESCENT           1.09814 1.33825 0.01635          0.00010      0.94440 1.15090 0.01406            0.00008
DESCENT    ON     1.09128 1.34740 0.01685          0.00008      0.93850 1.15876 0.01449            0.00007
APPROACH          1.12947 1.26981 0.02249          0.00009      0.52878 0.59469 0.01053            0.00004
TAXI              0.80075 1.80682 0.01596          0.00013      0.26558 0.59926 0.00529            0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-060
                                                         ENGINE  1.PLANE  7


ENGINE TYPE AND MODEL: O-320-E2A              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27474-27A
ENGINE TOTAL TIME:    1025 HRS.                         TSMOH:          HRS.
FUEL : 80 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         77.5    77.5              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.76   29.76              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0103 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  51*

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC   NO  ALD
  MODE    HEAT           PRES   FLOW FLOW  F/A TEMP
                         IN.HG  #/HR #/HR      DEG.F   *    *     PPMC  PPM PPM

IDLE-LOW              800        17.6  214 .082  269  1.9   2.8  1269         6
IDLE/TAXI            1000        22.3  256 .087  400  3.7   3.7  1379         6
RUN UP               1700        37.5  410 .092  986  6.7   5.1  2317
RUN UP-L.            1600        34.0  371 .092  919  6.5   4.9  2207
RUN UP-R.            1600        34.0  379 .090 1166  6.7   5.6  2207
TAKE OFF        FULL 2200        70.3  740 .095 1199  8.7   5.4  2649
CLIMB           FULL 2200        70.3  740 .095 1199  8.7   5.4  2648         6
DESCENT         65 % 2000        51.6  561 .092 1155  7.5   5.5  2152         6
DESCENT    ON   65 % 2000        52.7  575 .092 1121  7.1   5.3  2262         6
APPROACH        40 % 1500        28.1  301 .093  919  6.7   4.7  2538         6
TAXI                 1000        22.3  271 .082  504  2.9   4.1  1104         5

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)   (HCHO)                                   (NO2)   (HCHO)

IDLE-LOW          0.78069 1.80792 0.02538          0.00026      0.22900 0.53032 0.00745          0.00008
IDLE/TAXI         0.97352 1.52982 0.01766          0.00017      0.36183 0.56858 0.00656          0.00006
RUN UP            1.10444 1.32109 0.01859                       0.69028 0.82565 0.01162
RUN UP-L.         1.10937 1.31418 0.01834                       0.62864 0.74470 0.01039
RUN UP-R.         1.06131 1.39396 0.01702                       0.60141 0.78991 0.00964
TAKE OFF          1.20120 1.17161 0.01780                       1.40741 1.37274 0.02085
CLIMB             1.20120 1.17161 0.01780          0.00009      1.40741 1.37274 0.02085          0.00010
DESCENT           1.12560 1.29712 0.01572          0.00010      0.96801 1.11552 0.01352          0.00008
DESCENT    ON     1.11527 1.30826 0.01730          0.00010      0.97958 1.14909 0.01519          0.00009
APPROACH          1.14026 1.25696 0.02103          0.00011      0.53402 0.58868 0.00985          0.00005
TAXI              0.80891 1.79713 0.01499          0.00015      0.30064 0.66793 0.00557          0.00006
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-061
                                                          ENGINE  1.PLANE  7


ENGINE TYPE AND MODEL: O-320-E2A              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27474-27A
ENGINE TOTAL TIME:    1025 HRS.                         TSMOH:         HRS.
FUEL : 80 OCTANE

                               START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F           76.5    76.5              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG        29.76   29.76              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0099 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  50%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F   %     %    PPMC   PPM PPM

IDLE-LOW              800         19.9   249 .080          2.5   4.5   1793    11    7
IDLE/TAXI            1000         19.9   237 .084   415   5.2   6.2   2014    20    7
RUN UP               1700         34.0   369 .092   919  10.2   7.3   3724    67
RUN UP-L.            1600         32.8   359 .091   830  10.1   7.5   3393    43
RUN UP-R.            1600         32.8   359 .091   986  10.0   7.5   3283    51
TAKE OFF        FULL 2200         72.7   764 .095  1188  11.4   6.9   3062    59
CLIMB           FULL 2200         72.7   764 .095  1188  11.4   6.9   3062    59    8
DESCENT         65 % 2000         50.4   552 .091  1143  10.1   7.6   2952    70    8
DESCENT    ON   65 % 2000         50.4   562 .090  1121   9.5   7.8   2952   140    7
APPROACH        40 % 1500         25.8   280 .092   919  10.1   7.2   3945    59    8
TAXI                 1000         21.1   261 .081   504   4.6   7.0   1904    36    6

EXHAUST EMISSION MASS DATA :

  TEST    CARB   ---------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.69064 1.95353 0.02411 0.00050 0.00021     0.22906 0.64792 0.00800 0.00017 0.00007
IDLE/TAXI        0.88897 1.66560 0.01676 0.00056 0.00013     0.29484 0.55243 0.00556 0.00019 0.00004
RUN UP           1.13191 1.27301 0.02012 0.00122             0.64142 0.72137 0.01140 0.00069
RUN UP-L.        1.11664 1.34301 0.01826 0.00078             0.61043 0.71231 0.00998 0.00043
RUN UP-R.        1.11246 1.31112 0.01778 0.00093             0.60815 0.71674 0.00972 0.00051
TAKE OFF         1.21519 1.15580 0.01589 0.00103             1.47240 1.40044 0.01925 0.00125
CLIMB            1.21519 1.15580 0.01589 0.00103 0.00009     1.47240 1.40044 0.01925 0.00125 0.00011
DESCENT          1.11317 1.31628 0.01584 0.00141 0.00009     0.93506 1.10567 0.01330 0.00119 0.00008
DESCENT   ON     1.07084 1.38163 0.01620 0.00259 0.00008     0.89951 1.16057 0.01361 0.00218 0.00007
APPROACH         1.13200 1.26019 0.02152 0.00109 0.00010     0.48680 0.54532 0.00926 0.00047 0.00004
TAXI             0.77379 1.85038 0.01559 0.00099 0.00011     0.27212 0.65072 0.00548 0.00035 0.00004
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SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-062
ENGINE 1.PLANE 8

ENGINE TYPE AND MODEL: O-320-E3D ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29465-27A
ENGINE TOTAL TIME: 54 HRS. TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	79.0	79.0
ATMOSPHERIC PRES.-IN.HG	29.70	29.70

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0089 # H20/# DRY AIR TEST START : COLD
RELATIVE HUMIDITY : 42%

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		15.2	159	.096	314	4.2	2.9	4991	3	9
IDLE/TAXI			1000		18.8	192	.098	426	7.4	4.3	4547	6	10
RUN UP			1700		34.0	372	.091	953	9.9	7.4	2717	66	
RUN UP-L.			1600		31.6	351	.090	874	9.7	7.7	2717	46	
RUN UP-R.			1600		31.6	349	.091	1009	9.7	7.6	2717	46	
TAKE OFF		FULL	2300		75.0	802	.094	1256	10.9	7.2	2052	41	
CLIMB		FULL	2300		75.0	802	.094	1256	10.9	7.2	2052	41	7
DESCENT		65 %	2000		41.0	470	.087	1143	8.9	8.3	1885	60	7
DESCENT	ON	65 *	2000		38.7	494	.078	1177	5.5	10.4	1442	482	3
APPROACH		40 %	1500		27.0	290	.093	886	10.5	7.2	4215	44	8
TAXI			1000		18.8	216	.087	437	5.3	5.4	1775	21	6

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		1.09618	1.18940	0.06341	0.00013	0.00025	0.27770	0.30131	0.01606	0.00003	0.00006
IDLE/TAXI		1.20749	1.10259	0.03612	0.00016	0.00017	0.37835	0.34548	0.01132	0.00005	0.00005
RUN UP		1.11742	1.31253	0.01493	0.00122		0.63321	0.74377	0.00846	0.00069	
RUN UP-L.		1.00865	1.35801	0.01494	0.00085		0.57336	0.71522	0.00782	0.00045	
RUN UP-R.		1.09485	1.34800	0.01493	0.00085		0.57662	0.70995	0.00786	0.00045	
TAKE OFF		1.18099	1.22588	0.01082	0.00073		1.47624	1.53235	0.01353	0.00091	
CLIMB		1.18099	1.22588	0.01082	0.00073	0.00008	1.47624	1.53235	0.01353	0.00091	0.00010
DESCENT		1.01513	1.48767	0.01047	0.00112	0.00009	0.69368	1.01657	0.00715	0.00077	0.00006
DESCENT	ON	0.67989	2.02025	0.00868	0.00979	0.00004	0.43853	1.30306	0.00560	0.00631	0.00003
APPROACH		1.14919	1.23831	0.02246	0.00079	0.00009	0.51713	0.55724	0.01011	0.00036	0.00004
TAXI		0.96637	1.54723	0.01575	0.00063	0.00012	0.30280	0.48480	0.00494	0.00020	0.00004

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1271          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-063
                                                      ENGINE  1.PLANE  8


ENGINE TYPE AND MODEL: O-320-E3D              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29465-27A
ENGINE TOTAL TIME:      55 HRS.                          TSMOH:         HRS.
FUEL : 80 OCTANE

                           START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F       82.0    82.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    29.70   29.70              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0100 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  43%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                          IN.HG #/HR  #/HR        DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               800        15.2   181  .084  269  3.1   3.8  1709     9   7
IDLE/TAXI             1000        18.8   212  .088  381  5.8   5.3  2269    16   8
RUN UP                1700        32.8   360  .091  953 10.0   7.5  2885    71
RUN UP-L.             1600        32.8   362  .091  886  9.7   7.6  3389    56
RUN UP-R.             1600        31.6   350  .090 1009  9.8   7.7  2885    55
TAKE OFF         FULL 2300        72.7   785  .093 1278 10.8   7.5  1989    68
CLIMB            FULL 2300        72.7   785  .093 1278 10.8   7.5  1989    68  11
DESCENT          65 % 2000        43.4   500  .087 1155  8.7   8.5  1933    78   7
DESCENT     ON   65 % 2000        39.8   508  .078 1177  5.7  10.4  1485   548   6
APPROACH         40 % 1500        23.4   252  .093  897 10.5   7.1  4174    48   9
TAXI                  1000        17.6   204  .086  415  5.0   5.3  1709    22   8
```

```
EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW        0.86953 1.67494 0.02333 0.00041 0.00021     0.22028 0.42432 0.00591 0.00011 0.00005
IDLE/TAXI       1.01558 1.45833 0.01934 0.00046 0.00015     0.31821 0.45694 0.00606 0.00014 0.00005
RUN UP          1.11495 1.31405 0.01566 0.00130             0.60951 0.71835 0.00856 0.00071
RUN UP-L.       1.09068 1.34287 0.01855 0.00103             0.59624 0.73410 0.01014 0.00057
RUN UP-R.       1.09265 1.34909 0.01566 0.00101             0.57546 0.71052 0.00825 0.00053
TAKE OFF        1.15791 1.26359 0.01038 0.00120             1.40300 1.53105 0.01258 0.00145
CLIMB           1.15791 1.26359 0.01038 0.00120 0.00013     1.40300 1.53105 0.01258 0.00145 0.00015
DESCENT         0.99205 1.52310 0.01073 0.00146 0.00009     0.71758 1.10171 0.00776 0.00106 0.00006
DESCENT   ON    0.69576 1.99485 0.00882 0.01019 0.00008     0.46152 1.32325 0.00585 0.00676 0.00005
APPROACH        1.15583 1.22816 0.02237 0.00087 0.00011     0.45077 0.47898 0.00872 0.00034 0.00004
TAXI            0.94707 1.57755 0.01576 0.00068 0.00016     0.27781 0.46275 0.00462 0.00020 0.00005
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-064
ENGINE 1.PLANE 8

ENGINE TYPE AND MODEL: O-320-E3D ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29465-27A
ENGINE TOTAL TIME: 55 HRS. TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	78.0	78.0
ATMOSPHERIC PRES.-IN.HG	29.70	29.70

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0082 # H2O/# DRY AIR
RELATIVE HUMIDITY : 40%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		16.4	198	.083	258	2.9	3.9	1537	9	7
IDLE/TAXI			1000		19.9	225	.089	415	6.4	5.7	2416	18	6
RUN UP			1700		32.8	360	.091	874	9.8	7.4	2965	66	
RUN UP-L.			1600		32.8	363	.090	830	9.5	7.5	3623	43	
RUN UP-R.			1600		31.6	350	.090	942	9.5	7.5	3129	47	
TAKE OFF		FULL	2300		75.0	813	.092	1278	10.3	7.3	2086	27	
CLIMB		FULL	2300		75.0	813	.092	1278	10.3	7.3	2086	27	7
DESCENT		65 %	2000		44.5	517	.086	1188	8.3	8.4	1976	73	7
DESCENT	ON	65 %	2000		39.8	506	.079	1166	5.7	10.1	1537	443	6
APPROACH		40 %	1500		27.0	287	.094	919	10.6	7.0	3788	43	10
TAXI			1000		18.8	220	.085	448	4.8	5.4	1592	22	5

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.82714	1.74799	0.02134	0.00042	0.00021	0.22608	0.47778	0.00583	0.00012	0.00006
IDLE/TAXI		1.02858	1.43944	0.01890	0.00048	0.00010	0.34112	0.47741	0.00627	0.00016	0.00003
RUN UP		1.11089	1.31817	0.01636	0.00123		0.60729	0.72060	0.00894	0.00067	
RUN UP-L.		1.08521	1.34631	0.02015	0.00081		0.59325	0.73598	0.01101	0.00044	
RUN UP-R.		1.08830	1.35015	0.01745	0.00088		0.57317	0.71108	0.00919	0.00047	
TAKE OFF		1.14710	1.27757	0.01131	0.00049		1.43388	1.59696	0.01414	0.00062	
CLIMB		1.14710	1.27757	0.01131	0.00049	0.00008	1.43388	1.59696	0.01414	0.00062	0.00010
DESCENT		0.97420	1.54933	0.01129	0.00141	0.00009	0.72253	1.14909	0.00837	0.00104	0.00007
DESCENT	ON	0.70861	1.97311	0.00930	0.00985	0.00008	0.47005	1.30883	0.00617	0.00630	0.00005
APPROACH		1.16934	1.21347	0.02034	0.00078	0.00012	0.52620	0.54606	0.00915	0.00035	0.00005
TAXI		0.91899	1.62464	0.01484	0.00069	0.00010	0.28795	0.50905	0.00465	0.00022	0.00003

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-065
                                                         ENGINE  1.PLANE  9


ENGINE TYPE AND MODEL: O-320-E2A             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27848-27A
ENGINE TOTAL TIME:     767 HRS.                        TSMOH:        HRS.
FUEL : 80 OCTANE

                             START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F         81.0    81.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.80   29.80             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0095 # H20/# DRY AIR            TEST START : COLD
RELATIVE HUMIDITY :  42%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR      DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              800         12.9  156 .083  381  3.0  4.1   1436    17  13
IDLE/TAXI            1000         14.1  170 .083  471  4.9  6.5   1661    46   4
RUN UP               1700         35.2  401 .088  998  8.9  8.2   2506   199
RUN UP-L.            1650         35.2  404 .087  942  8.7  8.4   2337   136
RUN UP-R.            1650         34.2  392 .087 1076  8.6  8.4   2280   146
TAKE OFF        FULL 2200         73.8  808 .091 1379 10.6  7.8   2337   159
CLIMB           FULL 2200         73.8  808 .091 1379 10.6  7.8   2337   159   6
DESCENT         65 % 2000         51.6  579 .089 1312  9.8  8.2   2337    99   5
DESCENT   ON    65 % 2000         44.5  525 .085 1312  7.9  8.8   2055   321   5
APPROACH        40 % 1500         22.3  245 .091 1031  9.8  7.5   3294    96   6
TAXI                 1000         11.7  152 .077  594  2.9  6.3    985    46   5

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.82141 1.76409 0.01914 0.00076 0.00038     0.17660 0.37928 0.00412 0.00016 0.00008
IDLE/TAXI        0.84024 1.75153 0.01386 0.00130 0.00007     0.19746 0.41161 0.00326 0.00030 0.00002
RUN UP           1.01735 1.47296 0.01394 0.00355             0.59685 0.86413 0.00818 0.00208
RUN UP-L.        0.99546 1.51035 0.01302 0.00256             0.58400 0.88607 0.00764 0.00150
RUN UP-R.        0.99005 1.51962 0.01278 0.00276             0.56103 0.86112 0.00724 0.00156
TAKE OFF         1.12824 1.30463 0.01211 0.00278             1.38774 1.60469 0.01489 0.00342
CLIMB            1.12824 1.30463 0.01211 0.00279 0.00007     1.38774 1.60469 0.01489 0.00342 0.00008
DESCENT          1.06597 1.40162 0.01237 0.00177 0.00006     0.91674 1.20539 0.01064 0.00152 0.00005
DESCENT   ON     0.92682 1.62235 0.01174 0.00619 0.00006     0.68739 1.20324 0.00870 0.00459 0.00005
APPROACH         1.10251 1.32591 0.01804 0.00177 0.00007     0.40977 0.49280 0.00670 0.00066 0.00003
TAXI             0.61856 2.11163 0.01023 0.00161 0.00011     0.12062 0.41177 0.00199 0.00031 0.00002
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-066
ENGINE 1.PLANE 9

ENGINE TYPE AND MODEL: O-320-E2A ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27848-27A
ENGINE TOTAL TIME: 768 HRS. TSMOH: HRS.
FUEL : 80 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	82.5	82.5
ATMOSPHERIC PRES.-IN.HG	29.80	29.80

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0095 # H20/# DRY AIR
RELATIVE HUMIDITY : 40%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800		12.9	168	.077	291	1.9	4.7	1081	26	4
IDLE/TAXI			1000		12.9	166	.078	404	3.5	7.1	1414	59	7
RUN UP			1700		32.8	373	.088	964	9.0	8.2	2634	218	
RUN UP-L.			1650		31.6	360	.088	852	9.0	8.2	2468	141	
RUN UP-R.			1650		32.8	375	.088	1244	8.9	8.3	2523	139	
TAKE OFF		FULL	2200		70.3	765	.092	1278	10.6	7.6	2523	160	
CLIMB		FULL	2200		70.3	765	.092	1278	10.6	7.6	2523	160	7
DESCENT		65 %	2000		50.4	567	.089	1211	9.4	8.0	2357	131	4
DESCENT	ON	65 %	2000		41.0	485	.085	1211	7.9	8.9	2135	399	6
APPROACH		40 %	1500		17.6	193	.091	964	9.7	7.4	3355	114	7
TAXI			1000		11.7	154	.076	471	2.6	6.4	1026	61	5

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.56176	2.18368	0.01556	0.00126	0.00013	0.12478	0.46949	0.00335	0.00027	0.00003
IDLE/TAXI		0.64625	2.06010	0.01271	0.00179	0.00014	0.13894	0.44292	0.00273	0.00038	0.00003
RUN UP		1.02214	1.46344	0.01456	0.00407		0.55877	0.80001	0.00796	0.00222	
RUN UP-L.		1.02311	1.46483	0.01366	0.00263		0.53884	0.77148	0.00719	0.00139	
RUN UP-R.		1.01142	1.48223	0.01396	0.00260		0.55291	0.81029	0.00763	0.00142	
TAKE OFF		1.13933	1.28367	0.01320	0.00283		1.33492	1.50483	0.01547	0.00331	
CLIMB		1.13933	1.28367	0.01320	0.00283	0.00008	1.33492	1.50483	0.01547	0.00331	0.00009
DESCENT		1.05714	1.41380	0.01290	0.00242	0.00005	0.88799	1.18759	0.01084	0.00203	0.00004
DESCENT	ON	0.92094	1.63037	0.01212	0.00764	0.00007	0.62931	1.11409	0.00828	0.00522	0.00005
APPROACH		1.10340	1.32278	0.01958	0.00213	0.00009	0.32366	0.38802	0.00545	0.00062	0.00003
TAXI		0.56650	2.19132	0.01888	0.00219	0.00012	0.11847	0.42731	0.00212	0.00043	0.00002

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-067
                                                         ENGINE  1.PLANE  9



ENGINE TYPE AND MODEL: 0-320-E2A               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-27848-27A
ENGINE TOTAL TIME:     768 HRS.                          TSMOH:         HRS.
FUEL : 80 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       86.0    86.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   29.80   29.80                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0090 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  34%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              800        11.7  159 .074  269  1.4  5.0    936    16   7
IDLE/TAXI            1000        11.7  154 .076  392  3.1  7.3   1180    40   9
RUN UP               1700        31.6  360 .088  897  8.9  8.2   2608   137
RUN UP-L.            1650        30.5  346 .088  785  8.9  8.1   2498    88
RUN UP-R.            1650        30.5  349 .087  975  8.8  8.3   2443    96
TAKE OFF        FULL 2200        71.5  779 .092 1256 10.6  7.7   2443    98
CLIMB           FULL 2200        71.5  779 .092 1256 10.6  7.7   2443    98   7
DESCENT         65 % 2000        46.9  523 .090 1166  9.6  7.8   2278    68   7
DESCENT    ON   65 % 2000        44.5  517 .086 1166  8.4  8.5   2114   198   7
APPROACH        40 % 1500        17.6  194 .091  919 10.0  7.7   3486    77   3
TAXI                 1000        11.7  155 .076  437  2.5  6.4    906    40   6

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2       THC       NOX       ALD          CO       CO2       THC       NOX       ALD
                                                (NO2)     (HCHO)                                    (NO2)     (HCHO)

IDLE-LOW         0.42780 2.40091 0.01348 0.00080 0.00023    0.08342 0.46818 0.00263 0.00016 0.00004
IDLE/TAXI        0.58455 2.16312 0.01083 0.00124 0.00018    0.11399 0.42181 0.00211 0.00024 0.00004
RUN UP           1.01675 1.47209 0.01450 0.00257            0.53549 0.77530 0.00764 0.00135
RUN UP-L.        1.02330 1.46350 0.01398 0.00166            0.52019 0.74394 0.00711 0.00084
RUN UP-R.        1.00629 1.49146 0.01360 0.00180            0.51153 0.75816 0.00691 0.00092
TAKE OFF         1.13368 1.29411 0.01272 0.00172            1.35097 1.54215 0.01516 0.00205
CLIMB            1.13368 1.29411 0.01272 0.00172 0.00008    1.35097 1.54215 0.01516 0.00205 0.00010
DESCENT          1.20811 1.37907 0.01248 0.00126 0.00008    0.94429 1.07797 0.00975 0.00098 0.00007
DESCENT    ON    0.97362 1.54819 0.01193 0.00377 0.00009    0.72210 1.14824 0.00885 0.00280 0.00006
APPROACH         1.09888 1.32965 0.01865 0.00139 0.00004    0.32234 0.39003 0.00547 0.00041 0.00001
TAXI             0.55150 2.21861 0.00973 0.00145 0.00014    0.10754 0.43263 0.00190 0.00028 0.00003
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-068
                                                         ENGINE  6.PLANE  1


ENGINE TYPE AND MODEL: IO-540-C4B5            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6246-48
ENGINE TOTAL TIME:    1747 HRS.                        TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        77.0    77.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.82   29.82               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0112 # H20/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  60%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F  %    %      PPMC   PPM PPM

IDLE-LOW              800   12   15.2   135 .113  740  9.5   5.6 29243     7  28
IDLE/TAXI            1000   11   17.6   194 .090  762  8.5   7.1  9411    24   5
RUN UP               2000   15   56.3   605 .093 1211  9.8   6.7  3417    65
RUN UP-L.            1900   17   56.3   613 .092 1278  9.4   6.9  3193    53
RUN UP-R.            1900   18   57.4   632 .091 1256 10.0   7.6  2745    50
TAKE OFF        FULL 2600   28  117.2  1261 .093 1323 12.3   8.3  3081    84
CLIMB           75 % 2400   24  105.5  1138 .093 1244 10.3   7.1  2969    58   7
DESCENT         65 % 2000   23   78.5   847 .093 1211  9.7   6.7  3081    60   6
APPROACH        40 % 1900   15   46.9   512 .092 1121  9.1   6.7  3305    67   6
TAXI                 1000   12   17.6   149 .118  785 10.3   5.0 29975    10  22

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE     HEAT
                     CO       CO2       THC      NOX       ALD           CO       CO2       THC      NOX       ALD
                                                (NO2)     (HCHO)                                  (NO2)     (HCHO)

IDLE-LOW           1.04535 0.96832 0.15664 0.00013 0.00033      0.26482 0.24531 0.03968 0.00003 0.00008
IDLE/TAXI          1.01918 1.33778 0.05493 0.00047 0.00006      0.29496 0.39242 0.01611 0.00014 0.00002
RUN UP             1.15400 1.23988 0.01959 0.00126              1.04291 1.16342 0.01838 0.00118
RUN UP-L.          1.12179 1.29398 0.01855 0.00104              1.05261 1.21418 0.01741 0.00098
RUN UP-R.          1.10959 1.32517 0.01483 0.00091              1.06151 1.26774 0.01418 0.00087
TAKE OFF           1.16677 1.23724 0.01423 0.00131              2.27910 2.41674 0.02779 0.00256
CLIMB              1.15435 1.25041 0.01620 0.00107 0.00008      2.02972 2.19863 0.02948 0.00188 0.00015
DESCENT            1.15144 1.24979 0.01780 0.00117 0.00008      1.50645 1.63515 0.02329 0.00153 0.00010
APPROACH           1.11889 1.29455 0.01978 0.00135 0.00008      0.87468 1.01190 0.01546 0.00106 0.00006
TAXI               1.12197 0.85587 0.15417 0.00018 0.00026      0.32911 0.25106 0.04522 0.00005 0.00008
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-069
                                                          ENGINE  6.PLANE  1


ENGINE TYPE AND MODEL: IO-540-C4B5             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6246-48
ENGINE TOTAL TIME:   1740 HRS.                     TSMOH:          HRS.
FUEL : 100 OCTANE

                            START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F        82.0    83.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.82   29.82            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0124 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  52%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW  FLOW   F/A TEMP
                          IN.HG #/HR  #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW                800  12   17.6   128 .137  572  7.3  4.5 55740   15  40
IDLE/TAXI              1000  11   19.9   195 .102  684  7.5  6.3 21680   40  31
RUN UP                 2000  15   52.7   572 .092 1143  8.8  6.4  3585   76
RUN UP-L.              1900  16   51.6   562 .092 1143  8.4  6.4  7115   59
RUN UP-R.              1900  17   51.6   563 .092 1177  8.6  6.4  3193   61
TAKE OFF          FULL 2600  28  140.6  1480 .094 1278 10.0  6.9  2957   78
CLIMB             75 % 2400  24  111.3  1165 .096 1278 11.1  6.7  2633   43  19
DESCENT           65 % 2300  23   99.6  1053 .095 1244 11.7  7.3  2521   47   7
APPROACH          40 % 1900  19   60.9   644 .095 1087 11.0  6.9  2633   47   5
TAXI                   1000  12   15.2   124 .123  762 11.6  5.1 35965        24

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.83333 0.80724 0.30974 0.00028 0.00049       0.24444 0.23679 0.09086 0.00008 0.00014
IDLE/TAXI        0.93155 1.22965 0.13188 0.00082 0.00041       0.30896 0.40743 0.04348 0.00027 0.00014
RUN UP           1.12179 1.28204 0.02225 0.00159               0.98530 1.12606 0.01954 0.00140
RUN UP-L.        1.07404 1.28593 0.04428 0.00124               0.92368 1.10594 0.03808 0.00107
RUN UP-R.        1.11341 1.33206 0.02012 0.00130               0.95753 1.11977 0.01731 0.00112
TAKE OFF         1.19533 1.18906 0.01525 0.00141               2.80105 2.78637 0.03574 0.00329
CLIMB            1.21977 1.15403 0.01407 0.00078 0.00022       2.26002 2.14443 0.02611 0.00144 0.00041
DESCENT          1.20532 1.18178 0.01264 0.00080 0.00008       2.00084 1.96175 0.02099 0.00132 0.00013
APPROACH         1.20114 1.18398 0.01400 0.00084 0.00006       1.21916 1.20174 0.01421 0.00086 0.00006
TAXI             1.13353 0.78314 0.17108         0.00025       0.28716 0.19840 0.04334         0.00006
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171              DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                   RUN P-070
                                                            ENGINE  6.PLANE  1


ENGINE TYPE AND MODEL: IO-540-C4B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6246-48
ENGINE TOTAL TIME:   1749 HRS. 0¼
FUEL : 100 OCTANE                                     TSMOH:         HRS.

                              START  FINISH
INLET AIR TEMP.-DEG.F          82.0    82.0          SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG       29.82   29.92            FLOW RATE    7 LPM
                                                       TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0129 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  55%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               800  12   17.6   117 .151  560   6.3   4.4 72686    23  42
IDLE/TAXI             1000  11   21.1   210 .100  650   5.6   6.6 25881    52  31
RUN UP                2000  15   56.3   597 .094 1110   9.7   6.3  3585    62
RUN UP-L.             1900  16   56.3   609 .092 1110   9.2   6.6  3865   100
RUN UP-R.             1900  17   56.3   599 .094 1132   9.8   6.4  3473    67
TAKE OFF        FULL  2500  28  140.6  1460 .096 1289  12.1   7.0  3361    32
CLIMB           75 %  2400  24  111.3  1143 .097 1256  13.1   7.1  2913    17  14
DESCENT         65 %  2300  23   96.1  1005 .096 1256  12.1   7.2  2577    19   7
APPROACH        40 %  1900  19   63.3   662 .096 1121  11.5   6.8  2801    19   6
TAXI                  1000  12   15.2   125 .122  751  10.6   5.2 36973     8  31

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2      THC      NOX      ALD          CO       CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.69538  0.76318  0.39054  0.00042  0.00050      0.20398  0.22387  0.11456  0.00012  0.00015
IDLE/TAXI        0.75105  1.39098  0.16897  0.00115  0.00045      0.26412  0.48916  0.05942  0.00040  0.00016
RUN UP           1.17605  1.20029  0.02116  0.00123               1.10352  1.12624  0.01985  0.00116
RUN UP-L.        1.12728  1.27081  0.02305  0.00201               1.05776  1.19245  0.02163  0.00189
RUN UP-R.        1.17461  1.20543  0.02026  0.00132               1.10218  1.13110  0.01901  0.00124
TAKE OFF         1.23473  1.12248  0.01670  0.00054               2.89334  2.63035  0.03912  0.00126
CLIMB            1.26794  1.07989  0.01372  0.00027  0.00015      2.35292  2.00319  0.02546  0.00050  0.00027
DESCENT          1.22745  1.14737  0.01272  0.00032  0.00009      1.96533  1.83771  0.02038  0.00051  0.00012
APPROACH         1.22757  1.14065  0.01455  0.00033  0.00007      1.29508  1.20338  0.01536  0.00035  0.00007
TAXI             1.07827  0.83123  0.18308  0.00013  0.00034      0.27316  0.21058  0.04638  0.00003  0.00009
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-071
                                                          ENGINE  6.PLANE  2


ENGINE TYPE AND MODEL: IO-540-C4B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6239-48
ENGINE TOTAL TIME:   1760 HRS.-                          TSMOH:          HRS.
FUEL : 100 OCTANE

                               START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F           65.0    70.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG        29.80   29.80               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0130 # H20/# DRY AIR            TEST START : COLD
RELATIVE HUMIDITY :  95%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW                800  12   19.3  185 .104  852  9.5  6.2 19435    8   8
IDLE/TAXI              1000  12   22.9  280 .081  830  6.9  8.7  3184   52  10
RUN UP                 2000  18   61.5  670 .091 1267  9.5  7.3  2690   75
RUN UP-L.              1900       61.5  677 .091 1233  9.5  7.2  2580   66
RUN UP-R.              1900       59.8  655 .091 1390  9.6  7.1  2416   54
TAKE OFF          FULL 2500  28 149.4 1635 .091 1446 10.9  8.0  2361   56
CLIMB             75 % 2400  24 109.0 1200 .091 1412  9.9  7.6  2525   65   9
DESCENT           65 % 2300  23  96.7 1062 .091 1345  9.9  7.5  2525   65   7
APPROACH          40 % 1900  19  52.7  579 .091 1199  9.3  7.1  2745   55  13
TAXI                   1000  12  22.9  252 .091  807  8.7  7.1  8564   36   8

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL --------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         1.06791 1.09521 0.10635 0.00015 0.00010     0.34351 0.35229 0.03421 0.00005 0.00003
IDLE/TAXI        0.79236 1.80545 0.02047 0.00113 0.00014     0.30242 0.68908 0.00781 0.00043 0.00005
RUN UP           1.10385 1.33292 0.01522 0.00143             1.13145 1.36625 0.01560 0.00147
RUN UP-L.        1.11108 1.32327 0.01469 0.00127             1.13886 1.35635 0.01506 0.00130
RUN UP-R.        1.12386 1.38615 0.01377 0.00104             1.12011 1.38184 0.01372 0.00104
TAKE OFF         1.12971 1.30295 0.01191 0.00095             2.81299 3.24434 0.02966 0.00237
CLIMB            1.10604 1.33427 0.01373 0.00119 0.00011     2.00931 2.42393 0.02495 0.00217 0.00020
DESCENT          1.11231 1.32418 0.01381 0.00120 0.00008     1.79267 2.13413 0.02226 0.00193 0.00014
APPROACH         1.10618 1.32708 0.01589 0.00107 0.00017     0.97159 1.16562 0.01396 0.00094 0.00015
TAXI             1.03594 1.32852 0.04964 0.00070 0.00010     0.39538 0.50705 0.01895 0.00027 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-072
                                                         ENGINE  6.PLANE  2


ENGINE TYPE AND MODEL: IO-540-C4B5           ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6239-48
ENGINE TOTAL TIME:    1761 HRS.                     TSMOH:          HRS.
FUEL : 100 OCTANE

                              START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F          71.0    71.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       29.80   29.80             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0137 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  84%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               800  12   24.6   235 .105  673   5.8   6.7 32281    32  18
IDLE/TAXI             1000  12   24.6   269 .091  773   5.8   7.3 14494    58  14
RUN UP                2000  18   59.8   653 .092 1300   9.2   6.8  2855    96
RUN UP-L.             1900  18   61.5   675 .091 1233   9.0   6.8  2745    58
RUN UP-R.             1900  18   58.0   651 .089 1368   9.2   7.8  2690    57
TAKE OFF         FULL 2450  28  133.6  1459 .092 1368  10.4   7.6  2745    58
CLIMB            75 % 2400  24  105.5  1157 .091 1356   9.8   7.4  2525    68   8
DESCENT          65 % 2300  23   96.7  1056 .092 1334   9.7   7.1  2525    62   6
APPROACH         40 % 1900  19   58.0   636 .091 1222   9.3   7.0  2525    56   6
TAXI                  1000       22.9   221 .103  807   7.8   6.4 23223    58  14


EXHAUST EMISSION MASS DATA :

  TEST    CARB   ---------------- #/# FUEL ----------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO       CO2      THC      NOX      ALD        CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.73139 1.32767 0.19815 0.00066 0.00024    0.29987 0.54434 0.08124 0.00027 0.00010
IDLE/TAXI         0.79064 1.56375 0.09618 0.00130 0.00020    0.32416 0.64114 0.03943 0.00053 0.00008
RUN UP            1.12042 1.30136 0.01693 0.00172            1.11669 1.29702 0.01687 0.00171
RUN UP-L.         1.11045 1.31844 0.01649 0.00118            1.13822 1.35141 0.01690 0.00121
RUN UP-R.         1.05661 1.40772 0.01504 0.00108            1.02139 1.36080 0.01454 0.00104
TAKE OFF          1.12871 1.29616 0.01450 0.00103            2.51327 2.88612 0.03229 0.00230
CLIMB             1.11369 1.32149 0.01397 0.00127 0.00010    1.95824 2.32362 0.02456 0.00223 0.00017
DESCENT           1.12818 1.29766 0.01430 0.00118 0.00007    1.81825 2.09139 0.02304 0.00191 0.00012
APPROACH          1.11433 1.31803 0.01473 0.00110 0.00008    1.07719 1.27409 0.01424 0.00107 0.00007
TAXI              0.93631 1.20726 0.13570 0.00114 0.00018    0.35736 0.46077 0.05179 0.00044 0.00007
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171                DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                      RUN P-073
                                                              ENGINE  6.PLANE  2


ENGINE TYPE AND MODEL: IO-540-C4B5                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-6239-48
ENGINE TOTAL TIME:    1761 HRS.                       TSMOH:          HRS.
FUEL : 100 OCTANE

                              START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F          71.0    71.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       29.73   29.73            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0160 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  90%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM  MAN  FUEL  AIR  CALC EXH   CO   CO2    THC   NO  ALD
  MODE     HEAT            PRES FLOW  FLOW  F/A TEMP
                          IN.HG #/HR  #/HR     DEG.F   %    %    PPMC  PPM PPM

IDLE-LOW               800  12  24.6   227 .108  673  8.3  6.2 29613   14  25
IDLE/TAXI             1000  12  26.4   315 .084  762  6.4  8.1  5934   47  14
RUN UP                2000  18  61.5   659 .093 1300 10.1  6.8  4104   70
RUN UP-L.             1900  18  59.8   644 .093 1211 10.1  7.0  2995   83
RUN UP-R.             1900  19  59.8   643 .093 1323  9.9  6.9  6433   55
TAKE OFF         FULL 2450  28 124.8  1334 .094 1368 11.9  7.8  2662   47
CLIMB            75 % 2400  24 109.0  1173 .093 1356 11.0  7.5  2385   54   9
DESCENT          65 % 2300  23  98.4  1061 .093 1334 10.7  7.3  2440   54   9
APPROACH         40 % 1900  19  61.5   662 .093 1211 10.0  6.9  2773   52   9
TAXI                  1000  12  24.6   239 .103  785  8.7  6.3 19964   37  17

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ----------------
  MODE    HEAT
                  CO      CO2     THC     NOX     ALD        CO      CO2     THC     NOX     ALD
                                         (NO2)   (HCHO)                             (NO2)   (HCHO)

IDLE-LOW        0.94275 1.10664 0.16373 0.00026 0.00030   0.38653 0.45372 0.06713 0.00011 0.00012
IDLE/TAXI       0.84099 1.67259 0.03796 0.00101 0.00020   0.37003 0.73594 0.01670 0.00045 0.00009
RUN UP          1.15722 1.22431 0.02289 0.00132           1.18613 1.25492 0.02346 0.00135
RUN UP-L.       1.15128 1.25397 0.01662 0.00155           1.14744 1.24969 0.01656 0.00155
RUN UP-R.       1.12565 1.23285 0.03561 0.00103           1.12189 1.22874 0.03549 0.00102
TAKE OFF        1.18208 1.21756 0.01287 0.00077           2.45873 2.53252 0.02677 0.00160
CLIMB           1.16427 1.24743 0.01229 0.00094 0.00010   2.11589 2.26617 0.02232 0.00171 0.00019
DESCENT         1.16321 1.24708 0.01291 0.00096 0.00010   1.90767 2.04521 0.02118 0.00158 0.00017
APPROACH        1.15462 1.25194 0.01559 0.00099 0.00011   1.18344 1.28324 0.01594 0.00101 0.00011
TAXI            1.01521 1.15524 0.11340 0.00071 0.00021   0.41624 0.47365 0.04650 0.00029 0.00009
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-074
                                                          ENGINE  1.PLANE 10


ENGINE TYPE AND MODEL: O-320-E2A                 ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-16344-27A
ENGINE TOTAL TIME: 719.73 HRS.                         TSMOH:         HRS.
FUEL : 80 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        74.0    74.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.84   29.84                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0094 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  52%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH   CO   CO2   THC   NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW              800         15.2  181 .084  314  3.1  3.9  1537   14   6
IDLE/TAXI            1000         18.8  223 .084  448  4.7  5.6  1482   24   5
RUN UP               1700         35.2  397 .089 1031  8.3  7.3  2141   31
RUN UP-L.            1600         35.2  401 .088  964  8.1  7.4  1867   23
RUN UP-R.            1600         34.0  390 .088 1099  8.1  7.4  1812   22

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.85946 1.69912 0.02074 0.00064 0.00018     0.21773 0.43044 0.00525 0.00016 0.00005
IDLE/TAXI        0.89218 1.67046 0.01369 0.00075 0.00010     0.27955 0.52341 0.00429 0.00023 0.00003
RUN UP           1.04095 1.43970 0.01307 0.00064             0.61463 0.84403 0.00767 0.00037
RUN UP-L.        1.02412 1.47025 0.01149 0.00048             0.60081 0.86255 0.00674 0.00028
RUN UP-R.        1.02448 1.47076 0.01116 0.00046             0.58054 0.83343 0.00632 0.00026
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES           DATE 10/11/71
                                                                RUN P-075
                                                          ENGINE  1.PLANE 10


ENGINE TYPE AND MODEL: O-320-E2A
ENGINE SERIAL # : L-16344-27A                     ENGINE MFGR.: LYCOMING
ENGINE TOTAL TIME: 719.94 HRS.
FUEL : 80 OCTANE                                       TSMOH:         HRS.

                                START  FINISH
INLET AIR TEMP.-DEG.F           74.0    72.0           SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG        29.85   29.85             FLOW RATE    7 LPM
                                                         TRANS. TIME 1.6 SEC.
INLET AIR HUMIDITY: .0090 # H20/# DRY AIR
RELATIVE HUMIDITY :  52%                               TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F  %     %    PPMC   PPM PPM
IDLE-LOW             800          14.1  195  .072  303   1.0   4.6   1104   36   3
IDLE/TAXI           1000          16.4  224  .073  437   1.8   6.6    938   71   3
RUN UP              1700          35.2  399  .088 1043   7.9   7.1   2152  143
RUN UP-L.           1600          34.0  387  .088 1009   7.8   7.2   2207  127
RUN UP-R.           1600          34.0  386  .088 1087   7.9   7.1   1986   97
TAKE OFF       FULL 2200          71.5  812  .088 1323   8.4   7.5   2097  118
CLIMB          FULL 2200          71.5  812  .088 1323   8.4   7.5   2097  118   3
DESCENT        65 % 2000          45.7  486  .094 1256   6.1   4.1   1655  295   3
DESCENT   ON   65 % 2000          50.4  549  .092 1199   9.3   6.7   2428  102   3
APPROACH       40 % 1500          23.4  265  .088  953   8.0   7.2   2373  110   4
TAXI                1000          16.4  226  .073  471   1.6   6.2    772   98   3

EXHAUST EMISSION MASS DATA :

  TEST   CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ----------------
  MODE   HEAT
                 CO      CO2     THC     NOX     ALD        CO      CO2     THC     NOX      ALD
                                        (NO2)   (HCHO)                             (NO2)   (HCHO)
IDLE-LOW       0.34732 2.51362 0.01867 0.00205 0.00011   0.08162 0.59070 0.00439 0.00048 0.00003
IDLE/TAXI      0.42031 2.42177 0.01066 0.00272 0.00008   0.11488 0.66195 0.00291 0.00074 0.00002
RUN UP         1.02978 1.45436 0.01366 0.00306           0.60414 0.85322 0.00801 0.00180
RUN UP-L.      1.01638 1.47431 0.01400 0.00272           0.57595 0.83544 0.00793 0.00154
RUN UP-R.      1.03091 1.45595 0.01262 0.00208           0.58418 0.82504 0.00715 0.00118
TAKE OFF       1.03416 1.45099 0.01257 0.00239           1.23237 1.72910 0.01498 0.00284
CLIMB          1.03416 1.45099 0.01257 0.00239 0.00004   1.23237 1.72910 0.01498 0.00284 0.00005
DESCENT        1.16717 1.23278 0.01541 0.00927 0.00006   0.88900 0.93896 0.01174 0.00706 0.00005
DESCENT   ON   1.13558 1.28560 0.01443 0.00205 0.00004   0.95389 1.07990 0.01212 0.00172 0.00003
APPROACH       1.02781 1.45362 0.01484 0.00232 0.00006   0.40085 0.56691 0.00579 0.00091 0.00002
TAXI           0.40285 2.45307 0.00946 0.00405 0.00008   0.11011 0.67051 0.00259 0.00111 0.00002
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-076
                                                         ENGINE  1.PLANE 10


ENGINE TYPE AND MODEL: O-320-E2A                  ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-16344-27A
ENGINE TOTAL TIME: 720.12 HRS.                            TSMOH:        HRS.
FUEL : 80 OCTANE

                             START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F         71.0    72.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.85   29.85               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0093 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  57%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               800       14.1  189 .074  280  1.4   4.4    933    23    3
IDLE/TAXI             1000       14.1  186 .076  426  2.4   6.1   1200    46    3
RUN UP                1700       34.0  383 .089  998  7.8   6.8   2196   119
RUN UP-L.             1600       32.8  373 .088  942  7.6   7.0   2086    92
RUN UP-R.             1600       34.0  383 .089 1054  8.0   6.9   1976    81
TAKE OFF          FULL 2200       69.1  790 .087 1323  8.1   7.6   1867   110
CLIMB             FULL 2200       69.1  790 .087 1323  8.1   7.6   1867   110    4
DESCENT           65 % 2000       41.0  503 .082 1233  6.2   8.5   1592   196    3
DESCENT     ON    65 % 2000       44.5  517 .086 1199  7.5   7.6   1976   305    3
APPROACH          40 % 1500       22.3  254 .088  919  7.7   7.2   2306   111    4
TAXI                  1000       14.1  191 .073  448  1.8   6.2    988   102    3

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.47116 2.32694 0.01528 0.00127 0.00011     0.11072 0.54603 0.00359 0.00030 0.00003
IDLE/TAXI        0.55215 2.20533 0.01353 0.00174 0.00007     0.12976 0.51025 0.00318 0.00041 0.00002
RUN UP           1.04389 1.43009 0.01431 0.00262             0.59154 0.81038 0.00811 0.00148
RUN UP-L.        1.01788 1.47324 0.01360 0.00202             0.55644 0.80537 0.00743 0.00111
RUN UP-R.        1.05094 1.42440 0.01264 0.00175             0.59553 0.80716 0.00716 0.00099
TAKE OFF         1.01122 1.49097 0.01135 0.00226             1.16459 1.71711 0.01307 0.00260
CLIMB            1.01122 1.49097 0.01135 0.00226 0.00005     1.16459 1.71711 0.01307 0.00260 0.00006
DESCENT          0.82755 1.78285 0.01034 0.00430 0.00004     0.56549 1.21828 0.00707 0.00294 0.00003
DESCENT   ON     0.97237 1.54839 0.01247 0.00650 0.00004     0.72118 1.14839 0.00925 0.00492 0.00003
APPROACH         1.00932 1.48309 0.01471 0.00239 0.00006     0.37513 0.55121 0.00547 0.00089 0.00002
TAXI             0.44081 2.38595 0.01178 0.00410 0.00008     0.10359 0.56070 0.00277 0.00096 0.00002
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES

DATE 10/11/71
RUN P-077
ENGINE 5.PLANE 2

ENGINE TYPE AND MODEL: IO-470-C
ENGINE SERIAL # : 71018-7-C
ENGINE TOTAL TIME: 760.5 HRS.
FUEL : 100 OCTANE

ENGINE MFGR.: CONTINENTAL
TSMOH: HRS.

	START	FINISH
INLET AIR TEMP.-DEG.F	71.0	76.0
ATMOSPHERIC PRES.-IN.HG	30.15	30.15

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0104 # H20/# DRY AIR
RELATIVE HUMIDITY : 60%

TEST START : COLD

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			700	18	19.3	108	.178	359	4.4	2.9	71867	2	69
IDLE/TAXI			1000	16	26.4	233	.113	560	6.7	5.3	32968	7	41
RUN UP			1700	18	38.7	435	.089	986	7.6	6.6	3220	52	
RUN UP-L.			1625	19	38.7	445	.087	964	6.9	6.9	3173	42	
RUN UP-R.			1625	19	31.6	362	.087	975	7.0	6.7	2786	41	
TAKE OFF		FULL	2550	29	107.2	1296	.083	1412	6.1	7.9	1959	191	
CLIMB		75 %	2450	25	86.1	1030	.083	1401	6.0	7.7	1848	331	7
DESCENT		65 %	2300	25	73.8	872	.085	1312	6.3	7.2	2290	234	6
APPROACH		40 %	2100	23	52.7	622	.085	1222	6.2	7.0	2179	201	6
TAXI			1000	17	33.4	255	.131	706	6.6	4.1	43865	16	30

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.60239	0.62391	0.47895	0.00004	0.00101	0.19377	0.20069	0.15406	0.00001	0.00033
IDLE/TAXI		0.86870	1.07986	0.20808	0.00015	0.00057	0.38223	0.47514	0.09155	0.00007	0.00025
RUN UP		1.03791	1.41639	0.02146	0.00117		0.66945	0.91357	0.01384	0.00075	
RUN UP-L.		0.96938	1.52331	0.02170	0.00097		0.62525	0.98253	0.01400	0.00063	
RUN UP-R.		0.99318	1.49383	0.01924	0.00096		0.52308	0.78675	0.01013	0.00050	
TAKE OFF		0.85224	1.73442	0.01332	0.00438		1.52267	3.09883	0.02380	0.00783	
CLIMB		0.85705	1.72839	0.01285	0.00777	0.00011	1.22987	2.48024	0.01844	0.01115	0.00015
DESCENT		0.91012	1.63450	0.01610	0.00555	0.00009	1.11944	2.01043	0.01981	0.00683	0.00011
APPROACH		0.91644	1.62594	0.01568	0.00488	0.00010	0.80494	1.42812	0.01377	0.00429	0.00008
TAXI		0.86766	0.84700	0.28071	0.00035	0.00042	0.48300	0.47150	0.15626	0.00019	0.00024

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-078
                                                        ENGINE  5.PLANE  2


ENGINE TYPE AND MODEL: IO-470-C                ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 71918-7-C
ENGINE TOTAL TIME:  760.0 HRS.                          TSMOH:        HRS.
FUEL : 100 OCTANE

                          START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F      79.0    80.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.15   30.15               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0094 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  44%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              700   17    5.3    39 .134  370  4.3   4.1 48212     3  53
IDLE/TAXI            1000   16   10.5   117 .090  639  5.3   7.4 14770    28  35
RUN UP               1740   18   26.4   292 .090  964  7.7   6.3  3344    69
RUN UP-L.            1625   19   22.9   263 .087  897  5.9   5.5          49
RUN UP-R.            1625   19   22.9   258 .088  964  6.9   6.2  2620    56
TAKE OFF        FULL 2550   29   66.8   795 .084 1368  6.3   7.5  2229   281
CLIMB           75 % 2450   25   61.5   744 .083 1390  5.8   7.6  1728   319   8
DESCENT         65 % 2300   25   59.8   713 .084 1345  6.2   7.4  2006   281   9
APPROACH        40 % 2100   23   36.9   433 .085 1211  6.5   7.1  2508   285  22
TAXI                 1000   17   14.1   115 .122  695  7.6   4.6 37120    16  33

EXHAUST EMISSION MASS DATA :

  TEST    CARB   ---------------- #/# FUEL ---------------    ----------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW         0.64505 0.96653 0.35206 0.00007 0.00085      0.05698 0.08537 0.03110 0.00001 0.00008
IDLE/TAXI        0.74146 1.62681 0.10059 0.00064 0.00052      0.12976 0.28469 0.01760 0.00011 0.00009
RUN UP           1.06539 1.36978 0.02252 0.00157              0.46877 0.60270 0.00991 0.00069
RUN UP-L.
RUN UP-R.        1.02417 1.44614 0.01993 0.00137              0.39089 0.55194 0.00723 0.00052
TAKE OFF         0.89104 1.66692 0.01535 0.00653              0.99203 1.85583 0.01709 0.00727
CLIMB            0.84753 1.74516 0.01229 0.00766 0.00013      0.86872 1.78879 0.01260 0.00785 0.00013
DESCENT          0.89102 1.67118 0.01403 0.00663 0.00014      0.88805 1.66561 0.01399 0.00661 0.00014
APPROACH         0.93075 1.59762 0.01748 0.00482 0.00034      0.57241 0.98254 0.01075 0.00297 0.00021
TAXI             0.94729 0.90100 0.22523 0.00033 0.00044      0.22261 0.21173 0.05293 0.00008 0.00010
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN R-079
                                                          ENGINE  5.PLANE  2


ENGINE TYPE AND MODEL: IO-470-C                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 71018-7-C
ENGINE TOTAL TIME:  761.1 HRS.                             TSMOH:        HRS.
FUEL : 100 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        90.0    80.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.15   30.15              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0092 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  43%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2   THC    NO  ALD
  MODE    HEAT            PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW               700  17   5.3   30 .173  460  4.2  3.4 76585    3  94
IDLE/TAXI             1000  16   7.0   63 .112  751  6.7  5.4 31293   14  45
RUN UP                1700  18  19.3  210 .092 1099  7.8  5.8  4502   57
RUN UP-L.             1625  19  22.9  264 .087 1099  6.6  6.9  4063   42
RUN UP-R.             1625  19  22.9  264 .086 1143  6.6  6.7  2745   40
TAKE OFF         FULL 2550  29 103.7 1200 .086 1401  6.8  6.9  2196  216
CLIMB            75 % 2450  26  79.1  966 .082 1469  5.5  7.6  1482  298  19
DESCENT          65 % 2300  25  63.3  748 .085 1368  6.1  7.0  2141  240   8
APPROACH         40 % 2100  23  38.7  456 .085 1334  6.2  7.0  2470  191  13
TAXI                  1000  17   5.3   42 .126  830  6.3  4.8 45457   14  64

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                   (NO2)    (HCHO)

IDLE-LOW        0.54593 0.69448 0.48458 0.00005 0.00131     0.04822 0.06135 0.04280 0.00001 0.00012
IDLE/TAXI       0.87255 1.10511 0.19838 0.00030 0.00063     0.10180 0.12893 0.02314 0.00003 0.00007
RUN UP          1.10105 1.28658 0.03094 0.00132             0.35417 0.41385 0.00995 0.00043
RUN UP-L.       0.94130 1.54642 0.02821 0.00098             0.35926 0.59022 0.01077 0.00038
RUN UP-R.       0.96431 1.53930 0.01952 0.00096             0.36804 0.58712 0.00745 0.00037
TAKE OFF        0.96890 1.54494 0.01523 0.00506             1.67458 2.67018 0.02632 0.00874
CLIMB           0.82338 1.78792 0.01080 0.00733 0.00030     1.08549 2.35707 0.01424 0.00966 0.00040
DESCENT         0.90869 1.63861 0.01553 0.00587 0.00013     0.95866 1.72874 0.01638 0.00620 0.00013
APPROACH        0.91445 1.62242 0.01773 0.00463 0.00021     0.58982 1.04646 0.01144 0.00299 0.00013
TAXI            0.79862 0.95617 0.28050 0.00029 0.00097     0.07054 0.08446 0.02478 0.00003 0.00008
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                                                                  DATE 10/11/71
SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171                     RUN P-080
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES              ENGINE  2.PLANE  4


                                                  ENGINE MFGR.: LYCOMING
ENGINE TYPE AND MODEL: IO-360-B1E
ENGINE SERIAL # : L-4835-51A                             TSMOH:         HRS.
ENGINE TOTAL TIME: 1179.3 HRS.
FUEL : 100 OCTANE
                                                      SAMPLE LINE :
                             START  FINISH              FLOW RATE    7 LPM
INLET AIR TEMP.-DEG.F         80.0    85.0              TRANS. TIME 1.6 SEC.
ATMOSPHERIC PRES.-IN.HG      30.15   30.15
                                                      TEST START : COLD
INLET AIR HUMIDITY: .0093 # H20/# DRY AIR
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :

                                                         CO  CO2   THC   NO  ALD
  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F   *    %    PPMC  PPM PPM

IDLE-LOW                800  12  12.3  122 .101  628  7.7  5.0 16217   10  35
IDLE/TAXI              1000  12  15.8  182 .087  695  6.5  6.7  4336   36  23
RUN UP                 2000  19  28.1  373 .075 1312  3.4  8.0  1689  627
RUN UP-L.              1900  19  21.1  279 .076 1300  3.5  8.9  1520  302
RUN UP-R.              1900  19  28.1  372 .076 1323  3.5  8.8  1351  302
TAKE OFF          FULL 2600  29  54.5  639 .085 1401  6.5  7.1  2027  219
CLIMB             75 % 2500  25  43.9  572 .077 1435  4.0  8.7  1409  769   7
DESCENT           65 % 2350  23  38.7  516 .075 1401  3.2  8.9  1351  907  11
APPROACH          40 % 1900  20  28.1  354 .079 1256  4.7  8.1  1971  387   7
TAXI                   1000  12  14.1  155 .091  740  7.1  5.9  5856   30  11


EXHAUST EMISSION MASS DATA :
                                                                    ---------------- #/ MIN ----------------
  TEST    CARB  --------------- #/# FUEL ---------------
  MODE    HEAT                                                        CO      CO2     THC     NOX     ALD
                   CO      CO2     THC     NOX     ALD                                        (NO2)   (HCHO)
                                           (NO2)   (HCHO)

IDLE-LOW         1.00992 1.19541 0.10354 0.00022 0.00049          0.20703 0.24506 0.02123 0.00004 0.00010
IDLE/TAXI        0.94558 1.53163 0.03971 0.00086 0.00036          0.24900 0.40333 0.00809 0.00023 0.00009
RUN UP           0.54518 2.21739 0.01318 0.01652                  0.25533 1.03844 0.00617 0.00774
RUN UP-L.        0.55303 2.20987 0.01169 0.00784                  0.19448 0.77714 0.00411 0.00276
RUN UP-R.        0.55823 2.20558 0.01049 0.00791                  0.26144 1.03295 0.00491 0.00371
TAKE OFF         0.93400 1.60319 0.01418 0.00517                  0.84834 1.45623 0.01288 0.00470
CLIMB            0.61782 2.11163 0.01059 0.01951 0.00012          0.45204 1.54501 0.00775 0.01428 0.00008
DESCENT          0.51873 2.26711 0.01066 0.02415 0.00019          0.33458 1.46229 0.00688 0.01558 0.00012
APPROACH         0.71721 1.94236 0.01464 0.00970 0.00011          0.33589 0.90967 0.00686 0.00454 0.00005
TAXI             1.03651 1.35352 0.04162 0.00072 0.00017          0.24358 0.31808 0.00978 0.00017 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-081
                                                         ENGINE  2.PLANE  4


ENGINE TYPE AND MODEL: IO-360-B1E             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4835-51A
ENGINE TOTAL TIME: 1179.5 HRS.                        TSMOH:          HRS.
FUEL : 100 OCTANE

                          START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F      85.0    83.0                 FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG   30.15   30.15                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0094 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  38%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH    CO   CO2    THC   NO  ALD
  MODE    HEAT            PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC  PPM PPM

IDLE-LOW             800   12  12.3   96 .128  504  4.9   4.2 42922   17  28
IDLE/TAXI           1000   12  15.8  170 .093  650  5.5   6.3 13835   44  24
RUN UP              2000   19  29.9  383 .078 1267  4.2   8.4  2086  456
RUN UP-L.           1900   19  21.1  273 .077 1300  4.1   8.6  1812  237
RUN UP-R.           1900   19  29.9  384 .078 1312  4.3   8.5  1647  225
TAKE OFF       FULL 2600   29  54.5  643 .085 1368  6.5   7.4  2196  245
CLIMB          75 % 2500   25  43.9  521 .084 1356  6.1   7.1  2031  265   7
DESCENT        65 % 2350   23  38.7  469 .082 1323  5.6   7.4  1976  314   5
APPROACH       40 % 1900   20  28.1  353 .080 1244  4.7   7.9  1867  372   6
TAXI                1000   12  14.1  132 .106  785  8.9   4.9 13999   10  18


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------      --------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.72621 0.97817 0.30894 0.00041 0.00044     0.14897 0.20052 0.06333 0.00008 0.00009
IDLE/TAXI        0.82742 1.40936 0.10132 0.00109 0.00039     0.21789 0.39220 0.02668 0.00029 0.00010
RUN UP           0.65034 2.04394 0.01572 0.01160             0.32409 1.01856 0.00784 0.00578
RUN UP-L.        0.63128 2.08081 0.01358 0.00599             0.22200 0.73175 0.00478 0.00211
RUN UP-R.        0.65781 2.04337 0.01226 0.00565             0.32781 1.01828 0.00611 0.00282
TAKE OFF         0.91303 1.63343 0.01502 0.00565             0.82934 1.48370 0.01364 0.00514
CLIMB            0.90265 1.65099 0.01443 0.00644 0.00011     0.66044 1.20797 0.01070 0.00471 0.00008
DESCENT          0.84157 1.74754 0.01446 0.00775 0.00008     0.54281 1.12715 0.00932 0.00520 0.00005
APPROACH         0.72901 1.92557 0.01410 0.00948 0.00010     0.34142 0.90181 0.00660 0.00444 0.00005
TAXI             1.16130 1.00472 0.08892 0.00021 0.00025     0.27291 0.23611 0.02090 0.00005 0.00006
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SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-082
ENGINE 2-PLANE 4

ENGINE TYPE AND MODEL: IO-360-B1E ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4835-51A
ENGINE TOTAL TIME: 1179.7 HRS. TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	84.0	85.0
ATMOSPHERIC PRES.-IN.HG	30.15	30.15

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0089 # H20/# DRY AIR TEST START : HOT
RELATIVE HUMIDITY : 36%

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			900	13	12.3	95	.130	594	8.2	4.0	38540	5	26
IDLE/TAXI			1000	12	14.1	144	.098	650	7.5	5.8	11529	27	31
RUN UP			2000	19	29.9	354	.084	1166	6.0	7.0	2525	170	
RUN UP-L.			1900	20	19.3	229	.085	1143	6.1	7.1	2196	97	
RUN UP-R.			1900	20	28.1	333	.085	1188	6.1	7.1	2196	97	
TAKE OFF		FULL	2600	29	56.3	649	.087	1345	6.9	6.8	2251	159	
CLIMB		75 %	2500	26	43.9	499	.088	1267	7.2	6.6	2416	144	11
DESCENT		65 %	2350	23	38.7	440	.088	1222	7.1	6.5	2306	150	7
APPROACH		40 %	1900	20	28.1	316	.089	1121	7.1	6.2	2580	116	11
TAXI			10[illegible]	13	14.1	118	.119	762	9.7	4.3	25034	6	30

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		1.01344	0.77655	0.23177	0.00010	0.00034	0.20767	0.15919	0.04751	0.00002	0.00007
IDLE/TAXI		1.02921	1.25073	0.07701	0.00061	0.00046	0.24186	0.29392	0.01810	0.00014	0.00011
RUN UP		0.89794	1.64623	0.01839	0.00418		0.44748	0.82037	0.00917	0.00208	
RUN UP-L.		0.90154	1.64896	0.01580	0.00236		0.29000	0.53041	0.00508	0.00076	
RUN UP-R.		0.90154	1.64896	0.01580	0.00236		0.42222	0.77226	0.00740	0.00110	
TAKE OFF		0.94276	1.52195	0.01561	0.00372		0.92215	1.42810	0.01464	0.00349	
CLIMB		1.01698	1.46443	0.01661	0.00334	0.00017	0.74409	1.07184	0.01215	0.00244	0.00012
DESCENT		1.01815	1.46475	0.01610	0.00353	0.00011	0.65671	0.94476	0.01038	0.00228	0.00007
APPROACH		1.03862	1.42523	0.01837	0.00279	0.00017	0.48642	0.66748	0.00860	0.00131	0.00008
TAXI		1.16572	0.81205	0.14645	0.00012	0.00039	0.27394	0.19083	0.03442	0.00003	0.00009

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES               RUN P-083
                                                       ENGINE  1.PLANE 11


ENGINE TYPE AND MODEL: O-320-E2A            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29302-27A
ENGINE TOTAL TIME: 129.47 HRS.                   TSMOH:         HRS.
FUEL : 80 OCTANE

                              START  FINISH         SAMPLE LINE :
INLET AIR TEMP.-DEG.F          87.0    86.0           FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.15   30.15           TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0121 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  450

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F   %     %    PPMC   PPM PPM

RUN UP                1700        19.3  220  .088 1054   7.5   7.0   2505   144
RUN UP-R.             1600        19.3  221  .088 1076   7.4   7.0   2337    80
TAKE OFF         FULL 2250        42.2  472  .089 1300   8.4   7.0   2112     8
CLIMB            FULL 2250        42.2  472  .089 1300   8.4   7.0   2112     8  10
DESCENT          65 % 2000        24.6  295  .084 1233   6.3   7.7   1886    40   6
DESCENT     ON   65 % 2000        24.6  298  .083 1211   6.0   7.9   1830   108   5
APPROACH         40 % 1500        17.6  196  .090  942   7.9   6.5   2980    65   7
TAXI                  1000         5.3   65  .081  471   5.3   7.7   2112    68   4

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD        CO       CO2      THC      NOX      ALD
                                            (NO2)    (HCHO)                                (NO2)    (HCHO)

RUN UP           1.00843 1.47904 0.01640 0.00230               0.32430 0.47576 0.00528 0.00074
RUN UP-R.        1.00294 1.49085 0.01542 0.00178               0.32261 0.47956 0.00496 0.00057
TAKE OFF         1.06710 1.39750 0.01306 0.00017               0.75059 0.98291 0.00919 0.00012
CLIMB            1.06718 1.39750 0.01306 0.00017 0.00014       0.75059 0.98291 0.00919 0.00012 0.00010
DESCENT          0.80064 1.69130 0.01283 0.00092 0.00009       0.36106 0.69347 0.00526 0.00038 0.00004
DESCENT   ON     0.84499 1.74833 0.01255 0.00250 0.00008       0.34645 0.71681 0.00514 0.00102 0.00003
APPROACH         1.06660 1.37906 0.01906 0.00146 0.00010       0.31287 0.40452 0.00559 0.00043 0.00003
TAXI             0.79566 1.81651 0.01543 0.00168 0.00006       0.07028 0.16046 0.00136 0.00015 0.00001
```

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-004
                                                          ENGINE  1.PLANE 11


ENGINE TYPE AND MODEL: O-320-E2A               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29302-27A
ENGINE TOTAL TIME: 129.67 HRS.                          TSMOH:        HRS.
FUEL : 80 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        86.0    86.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.15   30.15              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0110 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  45%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %    %      PPMC   PPM PPM

IDLE-LOW              800         7.0   87 .081  291  4.4  7.1   2425    30   9
IDLE/TAXI            1000         5.3   63 .083  404  6.4  8.2   2647    51   7
RUN UP               1700        15.8  182 .087 1020  8.0  7.7   2536   109
RUN UP-L.            1600        15.8  183 .087  986  7.8  7.8   2425    96
RUN UP-R.            1600        15.8  183 .087 1076  7.8  7.8   2202    73
TAKE OFF        FULL 2250        38.7  436 .089 1300  9.0  7.8   2146     8
CLIMB           FULL 2250        38.7  436 .089 1300  9.0  7.8   2146     8   6
DESCENT         65 % 2000        22.9  274 .083 1222  7.0  8.6   1979    34   5
DESCENT    ON   65 % 2000        22.9  279 .082 1188  6.5  8.9   1867   109   4
APPROACH        40 % 1500        15.8  178 .089  919  8.4  7.3   2870    65   4
TAXI                 1000         5.3   66 .080  448  5.1  8.1   2146    62   6


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2       THC      NOX     ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.74317 1.88447 0.01994 0.00083 0.00016     0.08670 0.21985 0.00233 0.00010 0.00002
IDLE/TAXI        0.85392 1.71929 0.01719 0.00112 0.00010     0.07543 0.15187 0.00152 0.00010 0.00001
RUN UP           0.99455 1.50426 0.01535 0.00223             0.26190 0.39612 0.00404 0.00059
RUN UP-L.        0.97649 1.53448 0.01478 0.00197             0.25714 0.40408 0.00389 0.00052
RUN UP-R.        0.97786 1.53664 0.01344 0.00150             0.25750 0.40465 0.00354 0.00040
TAKE OFF         1.04910 1.42877 0.01218 0.00015             0.67667 0.92155 0.00785 0.00010
CLIMB            1.04910 1.42877 0.01218 0.00015 0.00007     0.67667 0.92156 0.00785 0.00010 0.00005
DESCENT          0.87881 1.69664 0.01209 0.00070 0.00007     0.33541 0.64755 0.00462 0.00027 0.00003
DESCENT    ON    0.82709 1.77962 0.01156 0.00228 0.00005     0.31567 0.67922 0.00441 0.00087 0.00002
APPROACH         1.04210 1.42314 0.01733 0.00132 0.00005     0.27442 0.37476 0.00456 0.00035 0.00001
TAXI             0.75403 1.88190 0.01544 0.00151 0.00010     0.06661 0.16623 0.00136 0.00013 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-085
                                                        ENGINE  1.PLANE 11


ENGINE TYPE AND MODEL: O-320-E2A                   ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-29302-27A
ENGINE TOTAL TIME: 129.86 HRS.
FUEL : 80 OCTANE                                         TSMOH:        HRS.

                              START  FINISH
INLET AIR TEMP.-DEG.F          88.0    88.0         SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG       30.15   30.15           FLOW RATE    7 LPM
                                                      TRANS. TIME 1.6 SEC.
INLET AIR HUMIDITY: .0130 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  49%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN  FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES  FLOW FLOW  F/A  TEMP
                          IN.HG  #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             800          7.0   87  .081         4.4   6.7  2317   27   8
IDLE/TAXI           1000          7.0   83  .084  448    6.8   8.0  2784   47   7
RUN UP              1700         15.8  182  .087 1043    7.2   7.0  2428   98
RUN UP-L.           1600         15.8  183  .086 1009    7.9   8.0  2317   80
RUN UP-R.           1600         15.8  182  .087 1065    7.1   7.0  2497   67
TAKE OFF        FULL 2250        38.7  435  .089 1289    8.0   6.9  2042    8
CLIMB           FULL 2250        38.7  435  .089 1289    8.0   6.9  2042    8   8
DESCENT         65 % 2000        21.1  253  .083 1211    6.2   7.7  1876   34   5
DESCENT    ON   65 % 2000        24.6  284  .087 1198    7.1   7.1  2097   67   4
APPROACH        40 % 1500        14.1  157  .089  942    7.7   6.5  2869   48   4
TAXI                1000          5.3   66  .080  448    4.6   7.0  2097   66   5

EXHAUST EMISSION MASS DATA :

 TEST   CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ----------------
 MODE   HEAT
                CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                          (NO2)    (HCHO)                               (NO2)    (HCHO)

IDLE-LOW       0.77011 1.84277 0.01974 0.00078 0.00015    0.08985 0.21499 0.00230 0.00009 0.00002
IDLE/TAXI      0.89491 1.65446 0.01732 0.00102 0.00010    0.10441 0.19302 0.00202 0.00012 0.00001
RUN UP         0.98873 1.51056 0.01623 0.00221            0.26037 0.39778 0.00427 0.00058
RUN UP-L.      0.97128 1.54561 0.01397 0.00162            0.25577 0.40701 0.00365 0.00043
RUN UP-R.      0.98406 1.52461 0.01415 0.00153            0.25914 0.40148 0.00373 0.00040
TAKE OFF       1.05048 1.42378 0.01305 0.00017            0.67755 0.91834 0.00842 0.00011
CLIMB          1.05048 1.42378 0.01305 0.00017 0.00011    0.67756 0.91834 0.00842 0.00011 0.00007
DESCENT        0.87287 1.70351 0.01286 0.00079 0.00008    0.30596 0.59917 0.00452 0.00028 0.00003
DESCENT   ON   0.97724 1.53566 0.01405 0.00152 0.00006    0.40067 0.62462 0.00576 0.00062 0.00002
APPROACH       1.05417 1.39839 0.01912 0.00108 0.00006    0.24773 0.32862 0.00449 0.00025 0.00001
TAXI           0.72352 1.92788 0.01606 0.00171 0.00008    0.06391 0.17030 0.00142 0.00015 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-086
                                                        ENGINE  6.PLANE  3


ENGINE TYPE AND MODEL: IO 540-C4B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-901-48
ENGINE TOTAL TIME: 1310.0 HRS.
FUEL : 100 OCTANE                                     TSMOH: 1310.0 HRS.

                              START  FINISH
INLET AIR TEMP.-DEG.F          92.0    93.0         SAMPLE LINE :
ATMOSPHERIC PRES.-IN.HG       29.90   29.90           FLOW RATE    7 LPM
                                                      TRANS. TIME 1.6 SEC.
INLET AIR HUMIDITY: .0156 # H20/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  65%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN  FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM
 IDLE-LOW            800  14
 IDLE/TAXI          1000  12               .135  628  8.5   4.5 52045        63
 RUN UP             2000                   .104  743  9.7   6.4 19599        46
 RUN UP-L.          1950                   .090 1222  9.3   7.4  2965
 RUN UP-R.          1950                   .090 1143  9.2   7.4  3074
 TAKE OFF      FULL 2600  29               .089 1233  9.1   7.5  2525
 CLIMB         75 % 2400  24               .098 1300 12.9   6.8  3349
 DESCENT       65 % 2300  23               .095 1256 12.6   7.7  3129        12
 APPROACH      40 % 1900  19               .095 1256 12.1   7.5  3184         9
 TAXI               1000  12               .091 1143  9.9   7.7  3294         6
                                           .131  673  8.4   4.8 50728        33

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)
 IDLE-LOW
 IDLE/TAXI      0.92605 0.77041 0.27602            0.00074
 RUN UP         1.06525 1.10447 0.10477            0.00054
 RUN UP-L.      1.00522 1.35695 0.01604
 RUN UP-R.      1.07921 1.36410 0.01755
 TAKE OFF       1.07096 1.38703 0.01447
 CLIMB          1.27742 1.05782 0.01614
 DESCENT        1.21235 1.16424 0.01466            0.00012
 APPROACH       1.20483 1.17354 0.01543            0.00010
 TAXI           1.09513 1.33849 0.01774            0.00007
                0.91174 0.81870 0.26803            0.00038
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-087
                                                         ENGINE  6.PLANE  3


ENGINE TYPE AND MODEL: IO 540-C4B5             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-941-48
ENGINE TOTAL TIME: 1318.0 HRS.                           TSMOH: 1318.0 HRS.
FUEL : 100 OCTANE

                           START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F       83.0    86.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   29.90   29.90              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0156 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  61%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW             800  12              .147  516  6.4  4.5 67866   28  59
IDLE/TAXI           1000  13              .121  650  7.5  5.4 43699   43  67
RUN UP              2000                  .087 1166  7.9  7.8  3752  115
RUN UP-L.           1950  17              .086 1177  7.4  7.9  3531   87
RUN UP-R.           1950  17              .087 1233  8.0  7.9  2924   71
TAKE OFF       FULL 2600  29              .097 1323 11.8  6.7  3366  131
CLIMB          75 % 2400  24              .094 1289 10.3  6.8  3200   45  12
DESCENT        65 % 2300  23              .092 1267 10.9  7.8  3090   51  21
APPROACH       40 % 1900  19              .088 1166  9.5  8.4  3255   78   6
TAXI                1000  12              .114  740  9.3  5.4 34126   75  27

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD           CO       CO2       THC       NOX      ALD
                                              (NO2)    (HCHO)                                     (NO2)    (HCHO)

IDLE-LOW          0.71768 0.79297 0.37046 0.00052 0.00071
IDLE/TAXI         0.86133 0.97453 0.24430 0.00031 0.00082
RUN UP            0.97469 1.51227 0.02253 0.00233
RUN UP-L.         0.93762 1.57296 0.02178 0.00181
RUN UP-R.         0.97988 1.52057 0.01743 0.00143
TAKE OFF          1.24244 1.10957 0.01725 0.00227
CLIMB             1.17269 1.21661 0.01774 0.00034 0.00015
DESCENT           1.13727 1.27097 0.01569 0.00037 0.00023
APPROACH          1.03301 1.43645 0.01724 0.00139 0.00007
TAXI              1.04135 0.95017 0.16421 0.00138 0.00032
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES
RUN P-008
ENGINE 6.PLANE 3

ENGINE TYPE AND MODEL: IO 540-C4B5
ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-901-49
ENGINE TOTAL TIME: 1318.5 HRS.
TSMOH: 1318.5 HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	86.0	87.0
ATMOSPHERIC PRES.-IN.HG	29.90	29.90

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0162 # H20/# DRY AIR
RELATIVE HUMIDITY : 60%
TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800	12			.131	538	7.5	5.2	56141	19	84
IDLE/TAXI			1000	12			.108	661	7.9	6.5	32278	40	62
RUN UP			2000	17			.086	1166	7.9	8.2	3504	140	
RUN UP-L.			1950	17			.085	1188	7.7	8.4	3062	98	
RUN UP-R.			1950	17			.086	1233	7.8	8.3	2621	98	
TAKE OFF		FULL	2600	29			.096	1289	12.1	6.9	3559	55	
CLIMB		75 %	2400				.093	1289	12.3	8.2	3338	55	15
DESCENT		65 %	2300	23			.091	1267	11.3	8.4	3173	67	10
APPROACH		40 %	1900				.087	1166	9.4	8.8	2952	105	9
TAXI			1000	12			.131	695	9.5	5.0	51479	35	32

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.81222	0.88493	0.29596	0.00034	0.00097					
IDLE/TAXI		0.88884	1.14923	0.17678	0.00074	0.00075					
RUN UP		0.95246	1.55356	0.02056	0.00277						
RUN UP-L.		0.93085	1.59574	0.01802	0.00195						
RUN UP-R.		0.94548	1.58099	0.01547	0.00195						
TAKE OFF		1.23985	1.11103	0.01775	0.00093						
CLIMB		1.17093	1.22669	0.01547	0.00086	0.00015					
DESCENT		1.11961	1.30787	0.01530	0.00109	0.00011					
APPROACH		1.00801	1.48291	0.01541	0.00195	0.00010					
TAXI		0.95897	0.79313	0.25296	0.00058	0.00035					

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-089
                                                          ENGINE  6.PLANE  4


ENGINE TYPE AND MODEL: IO-540-C4B5            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-1623-48
ENGINE TOTAL TIME: 1304.3 HRS.                          TSMOH: 1304.3 HRS.
FUEL : 100 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        86.0    86.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.90   29.90                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0140 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  52%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN  FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

 IDLE-LOW             800  16               .130   78  9.2   4.8 48245    5  76
 IDLE/TAXI           1000  14               .101  830  9.6   6.7 16803   16  47
 RUN UP              2000  21               .102 1211 12.4   5.6  5324   18
 RUN UP-L.           1900  22               .110 1256 10.5   5.5 21794   19
 RUN UP-R.           1775  28               .101 1300 12.2   5.8  5324   11
 TAKE OFF       FULL 2450  28               .103 1334 19.3   8.0  4769   11
 CLIMB          75 % 2400  24               .101 1278 15.2   6.9  4436   10  16
 DESCENT        65 % 2300  23               .101 1278 14.9   6.8  4492   11  13
 APPROACH       40 % 1900  19               .100 1177 13.8   6.5  5157   11  12
 TAXI                1000  19               .124  773  9.2   4.8 37931   14  40

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL --------------   ---------------- #/ MIN --------------
  MODE    HEAT
                    CO       CO2       THC      NOX      ALD           CO       CO2       THC       NOX      ALD
                                               (NO2)    (HCHO)                                     (NO2)    (HCHO)

 IDLE-LOW        0.96930 0.79471 0.24744 0.00009 0.00086
 IDLE/TAXI       1.05894 1.16136 0.09022 0.00029 0.00056
 RUN UP          1.32705 0.94177 0.02774 0.00032
 RUN UP-L.       1.14553 0.94292 0.11574 0.00034
 RUN UP-R.       1.32564 0.97541 0.02774 0.00019
 TAKE OFF        1.37806 0.89763 0.01658 0.00013
 CLIMB           1.33726 0.95393 0.01900 0.00014 0.00015
 DESCENT         1.33421 0.95684 0.01958 0.00016 0.00012
 APPROACH        1.31487 0.97322 0.02302 0.00017 0.00012
 TAXI            1.02549 0.84078 0.20581 0.00026 0.00048
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-090
                                                        ENGINE  6.PLANE  4


ENGINE TYPE AND MODEL: IO-540-C4B5                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-1623-48
ENGINE TOTAL TIME: 1304.5 HRS.                          TSMOH: 1304.5 HRS.
FUEL : 100 OCTANE

                            START  FINISH                SAMPLE LINE :
INLET AIR TEMP.-DEG.F        84.0    84.0                  FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.89   29.89                  TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0120 # H20/# DRY AIR               TEST START : HOT
RELATIVE HUMIDITY :  51%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             800  14    3.5    26 .137  650  8.5   4.6 55732    13  58
IDLE/TAXI           1000  13   15.8   142 .111  762  8.6   5.9 30777    20  60
RUN UP              2000  20   31.6   306 .103 1166 12.9   5.4  5767     9
RUN UP-L.           1875  21   29.9   276 .108 1289 12.2   5.6 13975    12
RUN UP-R.           1725  22   29.9   292 .102 1278 12.7   5.6  5767     7
TAKE OFF       FULL 2500  28  109.0  1047 .104 1289 14.2   5.7  4381    16
CLIMB          75 % 2300  24   49.2   477 .103 1244 13.3   5.6  4492    12  27
APPROACH       40 % 1900  19   26.4   256 .103 1121 13.0   5.6  5379    11  14
TAXI                1000  14   12.3   121 .102  818 10.9   5.0  6322    11  41


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLF-LOW         0.90281 0.76777 0.28815 0.00023 0.00056      0.05266 0.04479 0.01681 0.00001 0.00004
IDLF/TAXI        0.98175 1.03435 0.16714 0.00051 0.00072      0.25853 0.27238 0.04401 0.00014 0.00019
RUN UP           1.35537 0.89158 0.02950 0.00016              0.71353 0.46956 0.01553 0.00008
RUN UP-L.        1.26041 0.90915 0.07028 0.00020              0.62810 0.45306 0.03502 0.00010
RUN UP-R.        1.33436 0.92460 0.02950 0.00012              0.66496 0.46076 0.01470 0.00006
TAKE OFF         1.38476 0.87348 0.02080 0.00026              2.51564 1.58683 0.03778 0.00047
CLIMB            1.36328 0.90202 0.02241 0.00020 0.00030      1.11789 0.73966 0.01838 0.00017 0.00024
APPROACH         1.34724 0.91198 0.02714 0.00019 0.00016      0.59279 0.40127 0.01194 0.00008 0.00007
TAXI             1.30765 0.94260 0.03692 0.00022 0.00053      0.26807 0.19323 0.00757 0.00004 0.00011
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-091
                                                         ENGINE  6.PLANE  4


ENGINE TYPE AND MODEL: IO-540-C4B5            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-1623-48
ENGINE TOTAL TIME: 1304.7 HRS.                         TSMOH: 1304.7 HRS.
FUEL : 100 OCTANE

                            START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F        82.0    82.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.90   29.90            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0121 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  52%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW            800   14    8.8   61 .145  594  8.4  4.4 64260   26  70
IDLE/TAXI          1000   13    8.8   74 .119  717  8.9  5.6 39780   22  66
RUN UP             2000   20   29.9  289 .104 1166 13.5  5.6  6870   15
RUN UP-L.          1875   21   22.9  193 .118 1199 11.0  5.2 31140   15
RUN UP-R.          1750   22   28.1  275 .102 1256 13.0  5.7  6630    9
TAKE OFF      FULL 2500   28   72.1  700 .133 1278 14.7  6.2  4830   16
CLIMB         75 % 2300   24   52.7  509 .104 1244 13.9  5.7  4710   11  26
DESCENT       65 % 2200   23   40.4  393 .103 1211 13.5  5.7  4710   12  18
APPROACH      40 % 1900   19   26.4  255 .103 1099 13.2  5.5  5670   10  15
TAXI               1000   14   10.5   81 .131  773 10.7  4.7 46260    9  42

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2       THC       NOX      ALD          CO       CO2       THC       NOX       ALD
                                              (NO2)    (HCHO)                                   (NO2)     (HCHO)

IDLE-LOW        0.86653 0.71327 0.32269 0.00044 0.00077     0.12749 0.10461 0.04733 0.00006 0.00011
IDLE/TAXI       0.95528 0.94455 0.20785 0.00039 0.00076     0.14011 0.13853 0.03048 0.00006 0.00011
RUN UP          1.35316 0.88206 0.03352 0.00025             0.67433 0.43956 0.01670 0.00012
RUN UP-L.       1.12958 0.83911 0.15566 0.00025             0.43112 0.32026 0.05941 0.00010
RUN UP-R.       1.33158 0.91747 0.03306 0.00015             0.62362 0.42968 0.01548 0.00007
TAKE OFF        1.36347 0.90368 0.02191 0.00024             1.63843 1.08592 0.02621 0.00029
CLIMB           1.37354 0.88511 0.02266 0.00018 0.00028     1.20643 0.77742 0.01990 0.00016 0.00024
DESCENT         1.36114 0.90311 0.02312 0.00020 0.00019     0.91650 0.60809 0.01557 0.00013 0.00013
APPROACH        1.35880 0.88969 0.02841 0.00017 0.00017     0.59787 0.39146 0.01250 0.00007 0.00007
TAXI            1.05971 0.73147 0.22302 0.00015 0.00045     0.18545 0.12801 0.03903 0.00003 0.00008
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-092
ENGINE 7.PLANE 1

ENGINE TYPE AND MODEL: IO-520-A
ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 110140-3-A
ENGINE TOTAL TIME: 1555.7 HRS.
TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	75.0	79.0
ATMOSPHERIC PRES.-IN.HG	30.24	30.24

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0096 # H20/# DRY AIR
RELATIVE HUMIDITY : 49%
TEST START : COLD

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			700	15			.091	549	7.0	7.7	11621	12	14
IDLE/TAXI			1000	15			.095	684	8.5	7.1	11621	15	9
RUN UP			1700	17			.086	1076	7.5	7.9	2480	47	
RUN UP-L.			1600	18			.084	1043	6.9	8.4	2313	35	
RUN UP-R.			1600	18			.083	1076	6.7	8.4	2202	32	
TAKE OFF		FULL	2600	30			.073	1469	2.6	11.0	2870	359	
CLIMB		75 %	2550	25			.073	1469	2.8	10.9	1310	213	5
DESCENT		65 %	2200	22			.077	1390	4.4	9.8	1533		9
APPROACH		40 %	2000	19			.083	1211	6.5	8.2	2202		5
TAXI			1200	17			.098	740	8.3	7.1	16972		14

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.87525	1.51294	0.07073	0.00025	0.00019					
IDLE/TAXI		1.00574	1.32014	0.06693	0.00029	0.00011					
RUN UP		0.95060	1.57347	0.01530	0.00098						
RUN UP-L.		0.88112	1.68563	0.01438	0.00073						
RUN UP-R.		0.86737	1.70885	0.01308	0.00068						
TAKE OFF		0.37133	2.46574	0.01995	0.00842						
CLIMB		0.40151	2.45620	0.00914	0.00502	0.00008					
DESCENT		0.69799	2.12797	0.01031		0.00013					
APPROACH		0.86404	1.71289	0.01425		0.00007					
TAXI		0.96283	1.29427	0.09584		0.00017					

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-093
                                                        ENGINE  7.PLANE  1


ENGINE TYPE AND MODEL: IO-520-A                 ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 110140-3-A
ENGINE TOTAL TIME: 1555.9 HRS.                       TSMOH:         HRS.
FUEL : 130 OCTANE

                            START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F        79.0    80.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.24   30.24            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0090 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  42%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB  PWR RPM  MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW   F/A TEMP
                         IN.HG #/HR #/HR       DEG.F  %     %    PPMC   PPM PPM

IDLE-LOW            700  17               .128  381  6.8   4.6 45851         17
IDLE/TAXI          1000  17               .099 1435  7.2   7.0 22677         24
RUN UP             1700  17               .086  964  8.0   8.3  2731
RUN UP-L.          1600  18               .084  942  7.4   8.8  2511
RUN UP-R.          1600  18               .083  986  7.2   8.9  2511
TAKE OFF      FULL 2600  30               .074 1390  3.7  12.2  2952
CLIMB         75 % 2550  25               .072 1424  3.1  12.5  1241          9
DESCENT       65 % 2200  22               .077 1278  5.2  10.7  1517          9
APPROACH      40 % 1900  23               .081 1166  6.3   9.6  1848          5
TAXI               1200  17               .098  773  8.3   6.7 15642

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                           (NO2)    (HCHO)                                 (NO2)    (HCHO)


IDLE-LOW        0.84372 0.89688 0.27693          0.00023
IDLE/TAXI       0.86715 1.32482 0.13295          0.00031
RUN UP          0.95737 1.56086 0.01591
RUN UP-L.       0.89214 1.66716 0.01474
RUN UP-R.       0.87871 1.68768 0.01492
TAKE OFF        0.45312 2.34782 0.01760
CLIMB           0.39101 2.47762 0.00762          0.00012
DESCENT         0.64251 2.07756 0.00912          0.00012
APPROACH        0.77632 1.86014 0.01109          0.00007
TAXI            0.99381 1.26065 0.09117
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-094
                                                          ENGINE  7.PLANE  1


ENGINE TYPE AND MODEL: IO-520-A                     ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 110140-3-A
ENGINE TOTAL TIME: 1556.1 HRS.                          TSMOH:          HRS.
FUEL : 100 OCTANE

                             START   FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F         83.0     83.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.24    30.24                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0096 # H20/# DRY AIR               TEST START : HOT
RELATIVE HUMIDITY :  40%

EXHAUST EMISSION CONCENTRATION DATA :

   TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
   MODE    HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG  #/HR #/HR       DEG.F   %     %    PPMC   PPM PPM

IDLE-LOW            700    17                 .118  594  4.2   4.4 34110         39
IDLE/TAXI          1000    17                 .094  796  6.1   8.0 21068   30   41
RUN UP             1700    17                 .082 1099  6.5   8.8  2229   71
RUN UP-L.          1600    18                 .079 1110  5.3   9.7  1505  108
RUN UP-R.          1600    18                 .080 1054  6.2   9.7  1561  102
TAKE OFF      FULL 2600    30                 .073 1592  3.2  11.4  2787
CLIMB         75 % 2550    25                 .071 1592  2.4  11.8  1059   90   15
DESCENT       65 % 2200    22                 .077 1446  4.6   9.7  1393  418   15
APPROACH      40 % 1900    23                 .080 1300  5.7   8.9  1561  256   14
TAXI               1200    17                 .096  942  7.7   7.0 14882   29   19


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2       THC       NOX       ALD         CO       CO2       THC       NOX      ALD
                                                (NO2)     (HCHO)                                   (NO2)    (HCHO)

IDLE-LOW         0.69353 1.14173 0.27418         0.03069
IDLE/TAXI        0.74650 1.53845 0.12550 0.00060 0.00054
RUN UP           0.83049 1.76685 0.01386 0.00149
RUN UP-L.        0.69382 1.99542 0.01959 0.00232
RUN UP-R.        0.76586 1.83288 0.00939 0.00207
TAKE OFF         0.42656 2.38798 0.01808
CLIMB            0.33273 2.57073 0.00715 0.00205 0.00022
DESCENT          0.63184 2.09371 0.00931 0.00943 0.00022
APPROACH         0.76612 1.87979 0.01021 0.00565 0.00020
TAXI             0.94338 1.34769 0.08976 0.00058 0.00025
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-095
                                                       ENGINE  2.PLANE  2


ENGINE TYPE AND MODEL: IO-360-A1A             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-2928-51A
ENGINE TOTAL TIME: 1023.0 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                              START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F          89.0    89.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.20   30.20              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0104 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  36%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW  F/A TEMP
                            IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               800   13    5.9   58 .102  448  8.8   3.9             6  66
IDLE/TAXI             1000   12    9.4   96 .098  560  9.3   4.9                45
RUN UP                2000   17   27.0  324 .083 1031  6.9   8.2           448
RUN UP-L.             1950   17   27.0  323 .083  998  7.0   8.1           303
RUN UP-R.             1925   17   27.0  323 .083 1031  7.0   8.1           242
TAKE OFF         FULL 2700   30   98.4 1060 .093 1233  9.9   6.6           139
CLIMB            75 % 2500   25   70.3  778 .090 1233  9.2   7.0           193  18
DESCENT          65 % 2350   23   58.6  646 .091 1188  9.1   6.8           214  12
APPROACH         40 % 1900   20   31.6  371 .085 1076  7.5   7.8           402  15
TAXI                  1000   12    9.4   94 .100  673  9.4   4.5           113  26


EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE     HEAT
                    CO       CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)


IDLE-LOW
IDLE/TAXI
RUN UP
RUN UP-L.
RUN UP-R.
TAKE OFF
CLIMB
DESCENT
APPROACH
TAXI
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-096
                                                           ENGINE  2.PLANE  3


ENGINE TYPE AND MODEL: IO-360-A1A              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-2929-51A
ENGINE TOTAL TIME: 1023.3 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F         78.0    78.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.18   30.18               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0157 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  77%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG  #/HR #/HR       DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW             800   12    4.7   36 .129  549  8.8  4.3 40464    6  38
IDLE/TAXI           1000   11    8.2   79 .104  583  8.6  5.3 13711   17  30
RUN UP              2000   18   30.5  373 .082 1087  5.9  8.3  2620  378
RUN UP-L.           1975   18   30.5  374 .082 1065  5.8  8.3  2620  243
RUN UP-R.           1975   18   30.5  373 .082 1110  5.9  8.4  2341  210
TAKE OFF       FULL 2600   29   93.8 1035 .090 1233  9.1  7.1  2397  165
CLIMB          75 % 2500   25   70.3  774 .091 1244  9.2  7.0  2341  163  12
DESCENT        65 % 2350   23   58.6  660 .089 1199  8.1  7.0  2452  173  10
APPROACH       40 % 1900   18   29.3  340 .086 1054  7.2  7.4  2620  239  10
TAXI                1000   13    8.2   62 .131  673  8.8  4.2 42471   47  34

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE     HEAT
                     CO       CO2      THC      NOX      ALD         CO       CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          1.01790 0.78160 0.22784 0.00011 0.00047     0.07974 0.06123 0.01785 0.00001 0.00004
IDLE/TAXI         1.11692 1.08167 0.08668 0.00036 0.00042     0.15265 0.14783 0.01185 0.00005 0.00006
RUN UP            0.82913 1.78871 0.01749 0.00852             0.41131 0.90926 0.00889 0.00433
RUN UP-L.         0.80096 1.80117 0.01761 0.00551             0.40715 0.91559 0.00895 0.00280
RUN UP-R.         0.80512 1.80128 0.01555 0.00471             0.40927 0.91565 0.00790 0.00239
TAKE OFF          1.09785 1.34603 0.01408 0.00327             1.71631 2.10429 0.02201 0.00511
CLIMB             1.11029 1.32752 0.01375 0.00323 0.00016     1.30089 1.55542 0.01611 0.00379 0.00018
DESCENT           1.04691 1.42173 0.01543 0.00367 0.00014     1.02248 1.38955 0.01587 0.00359 0.00014
APPROACH          0.96084 1.55183 0.01702 0.00524 0.00014     0.46921 0.75781 0.00831 0.00256 0.00007
TAXI              1.01196 0.75897 0.23774 0.00089 0.00042     0.13830 0.10373 0.03249 0.00012 0.00006
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-097
                                                         ENGINE  2.PLANE  3


ENGINE TYPE AND MODEL: IO-360-A1A              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-2928-51A
ENGINE TOTAL TIME: 1023.5 HRS.                            TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         77.0    80.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.18   30.18              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0164 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  79%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE    HEAT            PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR     DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW              800  12   4.7   33 .140  504  7.5  4.5 60115   48  44
IDLE/TAXI            1000  11   8.2   76 .108  560  7.6  5.7 26352   86  42
RUN UP               2000  17  28.1  344 .082 1065  6.1  8.7  3019  415
RUN UP-L.            1950  18  28.1  342 .082 1020  6.2  8.6  3349  253
RUN UP-R.            1950  18  27.0  333 .081 1087  6.0  8.9  2635  243
TAKE OFF        FULL 2600  30  92.6 1017 .091 1256  9.2  7.0  2690  137
CLIMB           75 % 2500  25  70.3  793 .089 1256  8.5  7.4  2306  171  15
DESCENT         65 % 2350  23  50.4  586 .086 1188  7.6  7.9  2580  281  10
APPROACH        40 % 1900  18  27.0  315 .086 1054  7.3  7.7  2416  258   9
TAXI                 1000  12   9.4   81 .116  695  9.0  5.1 30305  104  23

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.82586 0.77867 0.32223 0.00087 0.00052     0.06469 0.06100 0.02524 0.00007 0.00004
IDLE/TAXI        0.94591 1.11483 0.15966 0.00176 0.00056     0.12927 0.15236 0.02182 0.00024 0.00008
RUN UP           0.80111 1.79547 0.01938 0.00895             0.37519 0.84088 0.00904 0.00419
RUN UP-L.        0.81247 1.77096 0.02136 0.00545             0.38051 0.82944 0.01001 0.00255
RUN UP-R.        0.78478 1.82928 0.01678 0.00522             0.35315 0.82318 0.00755 0.00235
TAKE OFF         1.10794 1.32471 0.01577 0.00271             1.70992 2.04447 0.02434 0.00418
CLIMB            1.04512 1.42979 0.01380 0.00345 0.00020     1.22453 1.67523 0.01617 0.00405 0.00023
DESCENT          0.95655 1.56249 0.01581 0.00581 0.00013     0.80354 1.31249 0.01328 0.00488 0.00011
APPROACH         0.94992 1.57453 0.01530 0.00552 0.00013     0.42746 0.70854 0.00689 0.00248 0.00006
TAXI             1.04200 0.92788 0.17000 0.00198 0.00029     0.16325 0.14537 0.02676 0.00031 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-098
                                                          ENGINE  2.PLANE  3


ENGINE TYPE AND MODEL: IO-360-A1A                ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-2920-51A
ENGINE TOTAL TIME: 1023.0 HRS.                            TSMOH:         HRS.
FUEL : 100 OCTANE

                           START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F       79.0    79.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.18   30.18                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0168 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  79%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH   CO  CO2    THC   NO  ALD
  MODE    HEAT          PRES  FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW            800  16   8.2   43 .190  538  8.5  3.2 99541    9  43
IDLE/TAXI          1000  14   8.2   57 .144  617  9.9  4.1 58782   14  60
RUN UP             2000  17  28.1  319 .088 1031  8.5  7.6  4381  154
RUN UP-L.          1950  18  28.1  316 .089  986  8.7  7.5  4882  108
RUN UP-R.          1950  18  29.3  331 .088 1009  8.5  7.5  3771   95
TAKE OFF      FULL 2600  30  94.9  993 .096 1211 10.9  6.5  2773   74
CLIMB         75 % 2500  25  85.6  900 .095 1222 10.6  6.5  2662   73  20
DESCENT       65 % 2350  23             .099 1188 11.6  6.0  2828   51  13
APPROACH      40 % 1900  19  27.0  310 .087 1031  7.3  7.1  2717  208  15
TAXI               1000  13   8.2   56 .148  673  9.1  3.6 54900   20  34

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE    HEAT
                   CO       CO2      THC      NOX      ALD         CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW         0.77853  0.46057  0.44381  0.00014  0.00042     0.10649  0.06295  0.06065  0.00002  0.00006
IDLE/TAXI        0.98777  0.64283  0.20550  0.00023  0.00064     0.13499  0.08785  0.03902  0.00003  0.00009
RUN UP           1.01936  1.43225  0.02558  0.00303              0.47740  0.67077  0.01198  0.00142
RUN UP-L.        1.03398  1.40071  0.02823  0.00211              0.48425  0.65600  0.01322  0.00099
RUN UP-R.        1.02938  1.42730  0.02223  0.00189              0.50268  0.69700  0.01086  0.00092
TAKE OFF         1.22294  1.14601  0.01514  0.00136              1.93429  1.81260  0.02395  0.00216
CLIMB            1.21059  1.16654  0.01400  0.00137  0.00024     1.72711  1.66426  0.02111  0.00195  0.00035
DESCENT          1.28652  1.04570  0.01527  0.00093  0.00015
APPROACH         0.98682  1.50823  0.01788  0.00462  0.00022     0.44407  0.67870  0.00805  0.00208  0.00010
TAXI             0.99221  0.61682  0.29139  0.00036  0.00040     0.13560  0.08430  0.03902  0.00005  0.00005
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-099
                                                         ENGINE  A.PLANE  2


ENGINE TYPE AND MODEL: IO-360-C               ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 50591-6-C
ENGINE TOTAL TIME:     700 HRS.                    TSMOH:          HRS.
FUEL : 100 OCTANE

                            START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F        76.0    79.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.23   30.23              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0162 # H20/# DRY AIR            TEST START : COLD
RELATIVE HUMIDITY :  81%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             700    18   17.6   236 .075  751   2.8 10.5   8571    48  26
IDLE/TAXI           1000    18   18.8   252 .074  762   3.4 11.1   5042    96  20
RUN UP              1700    18   22.3   291 .076  874   4.0 11.0   2409   267
RUN UP-L.           1600    20   19.9   273 .073  874   3.2 12.0   218[illegible]   210
RUN UP-R.           1640    19   16.4   221 .074  886   3.9 11.7   1513   167
TAKE OFF       FULL 2800    28   99.6  1159 .086 1155   8.0  8.4   4538   775
CLIMB          75 % 2500    25   70.3   885 .079 1177   5.8  9.9   2017   620   7
DESCENT        65 % 2400    22   44.5   546 .082 1043   6.6  9.3   2241   401  10
APPROACH       40 % 1800    19   23.4   299 .079  863   5.4 10.2   3081   285   8
TAXI                1000    17   17.6   201 .088  628   3.6 10.0  25209    67  27


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW          0.39226 2.31156 0.05845 0.00110 0.00039      0.11506 0.67806 0.01715 0.00032 0.00011
IDLE/TAXI         0.44943 2.30569 0.03244 0.00187 0.00028      0.14082 0.72245 0.01017 0.00059 0.00009
RUN UP            0.59348 2.13725 0.01450 0.00542              0.22058 0.79434 0.00539 0.00202
RUN UP-L.         0.41163 2.42566 0.01368 0.00444              0.13652 0.80451 0.00454 0.00147
RUN UP-R.         0.49187 2.31585 0.00927 0.00345              0.13423 0.63274 0.00253 0.00094
TAKE OFF          0.94143 1.55336 0.02600 0.01498              1.56277 2.57858 0.04315 0.02487
CLIMB             0.72340 1.94036 0.01225 0.01270 0.00009      0.84759 2.27345 0.01435 0.01488 0.00011
DESCENT           0.81183 1.79762 0.01342 0.00810 0.00013      0.60211 1.33323 0.00995 0.00601 0.00010
APPROACH          0.67324 1.99835 0.01870 0.00586 0.00011      0.26256 0.77936 0.00729 0.00228 0.00004
TAXI              0.44290 1.93331 0.15097 0.00135 0.00036      0.12992 0.56710 0.04427 0.00040 0.00010
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-100
                                                         ENGINE  A.PLANE  2


ENGINE TYPE AND MODEL: IO-360-C                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 50591-6-C
ENGINE TOTAL TIME:     700 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        79.0    80.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.24   30.24               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0162 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  75%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW FLOW  F/A TEMP
                          IN.HG  #/HR #/HR      DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW             700   18   21.1   257 .082  560  2.3   9.2 16636    94  46
IDLE/TAXI           1000   17   19.9   250 .080  605  3.4  10.1 11146    79  30
RUN UP              1700   18   22.3   292 .076  830  4.4  10.6  2884   269
RUN UP-L.           1600   19   19.9   269 .074  785  3.6  11.2  1941   163
RUN UP-R.           1600   19   18.6   252 .074  852  3.7  11.0  1608   153
TAKE OFF       FULL 2800   27   93.8  1110 .084 1155  7.6   8.8  4325   336
CLIMB          75 % 2500   25   63.3   820 .077 1211  5.0  10.5  1885   791  13
DESCENT        65 % 2400   22   41.0   509 .081 1076  6.1   9.3  2440   455  11
APPROACH       40 % 1800   19   27.0   335 .080  919  5.6   9.2  4048   269  10
TAXI                1000   17   19.9   234 .085  673  3.6   9.2 18466    56  29

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW         0.34654 2.17823 0.12201 0.00208 0.00074      0.12187 0.76601 0.04291 0.00073 0.00026
IDLE/TAXI        0.46141 2.15390 0.07363 0.00176 0.00044      0.15303 0.71433 0.02442 0.00053 0.00014
RUN UP           0.57040 2.16090 0.01821 0.00573              0.21215 0.80313 0.00677 0.00213
RUN UP-L.        0.47619 2.32803 0.01250 0.00354              0.15794 0.77213 0.00415 0.00117
RUN UP-R.        0.49340 2.30696 0.01045 0.00335              0.15473 0.72205 0.00327 0.00105
TAKE OFF         0.09549 1.62939 0.02481 0.00650              1.39995 2.54720 0.03870 0.01017
CLIMB            0.63210 2.00592 0.01160 0.01643 0.00018      0.66606 2.20065 0.01224 0.01733 0.00019
DESCENT          0.77335 1.85279 0.01506 0.02950 0.00015      0.52946 1.26607 0.01029 0.02649 0.00010
APPROACH         0.73047 1.88581 0.02570 0.00576 0.00014      0.32971 0.84861 0.01157 0.00259 0.00006
TAXI             0.48749 1.95768 0.12172 0.00125 0.00042      0.16160 0.64930 0.04037 0.00041 0.00014
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-101
                                                         ENGINE  0.PLANE  2



ENGINE TYPE AND MODEL: IO-360-C                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 50591-6-C
ENGINE TOTAL TIME:     700 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                           START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F       84.0    84.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.24   30.24                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0164 # H20/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  66%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH     CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW              700  18   16.4  199 .082  673  2.8  9.4 16470   42  42
IDLE/TAXI            1000  17   19.9  262 .076  729  3.4 10.4  9882   56  35
RUN UP               1700  18   22.3  293 .076  919  4.3 10.7  3404  309
RUN UP-L.            1600  20   19.9  267 .075  897  3.5 10.9  4721  150
RUN UP-R.            1600  19   19.9  272 .073  953  3.2 11.1  1537  177
TAKE OFF        FULL 2800  27   91.4 1076 .085 1289  7.8  8.8  4282  262
CLIMB           75 % 2500  25   59.8  781 .077 1356  4.7 10.6  2306  796  18
DESCENT         65 % 2400  22   42.2  538 .078 1267  5.5 10.1  2086  564


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                     CO      CO2      THC      NOX     ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW         0.40105 2.11574 0.11483 0.00099 0.00064      0.10962 0.57830 0.03139 0.00027 0.00018
IDLE/TAXI        0.45599 2.19184 0.06452 0.00123 0.00050      0.15124 0.72696 0.02140 0.00041 0.00017
RUN UP           0.55594 2.17389 0.02142 0.00656              0.20662 0.80796 0.00796 0.00244
RUN UP-L.        0.46676 2.28425 0.03065 0.00329              0.15491 0.75761 0.01016 0.00109
RUN UP-R.        0.43910 2.39350 0.01027 0.00399              0.14564 0.79385 0.00341 0.00132
TAKE OFF         0.90849 1.61066 0.02428 0.00501              1.38394 2.45357 0.03698 0.00754
CLIMB            0.60021 2.12720 0.01434 0.01670 0.00025      0.59821 2.12011 0.01429 0.01664 0.00025
DESCENT          0.69003 1.99122 0.01274 0.01162              0.48532 1.40049 0.00896 0.00818
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                   RUN P-102
                                                           ENGINE  A.PLANE  2


ENGINE TYPE AND MODEL: IO-360-C                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 50591-6-C
ENGINE TOTAL TIME:     700 HRS.                           TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         78.0    78.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.21   30.21              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0161 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  79%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  %    %      PPMC   PPM PPM

IDLE-LOW               700   18   15.2   157 .097  617  4.5  8.9 35935   22  40
IDLE/TAXI             1000   17   16.4   195 .089  673  5.6  9.3 19132   38  20
RUN UP                1700   18   25.8   311 .083  975  7.2  9.3  3660  137
RUN UP-L.             1600   20   24.6   299 .082  953  6.9  9.3  4769   80
RUN UP-R.             1600   19   22.3   276 .081  998  6.3  9.7  2773  108
TAKE OFF         FULL 2800   27   93.8  1185 .079 1312  5.7 10.3  4104  916
CLIMB            75 % 2500   25   64.5   838 .077 1390  5.0 10.8  2218  675  20
DESCENT          65 % 2400   22   45.7   577 .079 1278  6.0 10.4  2606  434  10
APPROACH         40 % 1800   19   25.8   337 .076  942  4.7 10.8  2939  395  22
TAXI                  1000   17   18.8   233 .080  887  4.0 10.6 11645   62  27


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT

                   CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW          0.52520 1.63229 0.20416 0.00042 0.00050      0.13305 0.41351 0.05172 0.00011 0.00013
IDLE/TAXI         0.66059 1.72394 0.10986 0.00074 0.00035      0.18056 0.47121 0.03003 0.00020 0.00010
RUN UP            0.84667 1.71855 0.02095 0.00265              0.36407 0.73897 0.00901 0.00114
RUN UP-L.         0.82060 1.73803 0.02761 0.00156              0.33644 0.71259 0.01132 0.00064
RUN UP-R.         0.76763 1.85729 0.01645 0.00216              0.28530 0.69029 0.00611 0.00080
TAKE OFF          0.68849 1.95518 0.02414 0.01819              1.37697 3.05816 0.03775 0.02843
CLIMB             0.61895 2.10089 0.01337 0.01373 0.00027      0.66537 2.25845 0.01437 0.01476 0.00029
DESCENT           0.71426 1.94551 0.01510 0.00849 0.00013      0.54403 1.48183 0.01150 0.00646 0.00010
APPROACH          0.59721 2.13120 0.01797 0.00815 0.00030      0.25379 0.91642 0.00773 0.00350 0.00013
TAXI              0.50324 2.09564 0.07132 0.00129 0.00036      0.15768 0.65563 0.02235 0.00048 0.00011
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SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-103
ENGINE 8.PLANE 3

ENGINE TYPE AND MODEL: IO-360-C ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 55651-6-D
ENGINE TOTAL TIME: 700 HRS. TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	79.0	81.0
ATMOSPHERIC PRES.-IN.HG	30.21	30.21

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0161 # H20/# DRY AIR
RELATIVE HUMIDITY : 74%

TEST START : COLD

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			700	17	19.9	160	.119	673	5.3	7.2	60010	29	37
IDLE/TAXI			1000	18	21.1	208	.101	717	5.1	8.4	39137	51	46
RUN UP			1700	17	31.6	381	.083	1031	7.1	9.2	4675	271	
RUN UP-L.			1600	18	35.2	437	.081	1020	6.3	10.0	4131	160	
RUN UP-R.			1600	18	22.3	273	.082	1065	6.6	9.5	5164	194	
TAKE OFF		FULL	2800	28	96.1	1118	.086	1300	7.4	7.9	4457		
CLIMB		75 %	2500	25	66.8	775	.086	1312	8.1	8.3	3370	213	19
DESCENT		65 %	2250	22	49.2	547	.090	1211	9.2	7.5	4566	164	28
APPROACH		40 %	1800	19	32.8	332	.099	1110	9.4	7.1	15655	88	57
TAXI			1000	17	21.1	158	.133	762	4.8	6.2	72566	58	61

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.56817	1.21291	0.31316	0.00051	0.00042	0.18844	0.40228	0.10386	0.00017	0.00014
IDLE/TAXI		0.58086	1.50341	0.21699	0.00095	0.00056	0.20427	0.52870	0.07631	0.00034	0.00020
RUN UP		0.83982	1.71005	0.02692	0.00527		0.44230	0.90063	0.01418	0.00277	
RUN UP-L.		0.74762	1.86480	0.02386	0.00312		0.43860	1.09402	0.01400	0.00183	
RUN UP-R.		0.78778	1.78187	0.03000	0.00380		0.29279	0.66226	0.01115	0.00141	
TAKE OFF		0.93211	1.56371	0.02733			1.49292	2.50454	0.04377		
CLIMB		0.95985	1.54558	0.01944	0.00415	0.00024	1.06863	1.72074	0.02164	0.00462	0.00027
DESCENT		1.06354	1.36245	0.02569	0.00311	0.00035	0.87210	1.11721	0.02107	0.00255	0.00028
APPROACH		1.03199	1.22489	0.08366	0.00159	0.00067	0.56415	0.66961	0.04574	0.00087	0.00037
TAXI		0.52146	1.05843	0.38375	0.00104	0.00071	0.18338	0.37221	0.13495	0.00036	0.00025

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN R-104
                                                           ENGINE  7.PLANE  2


ENGINE TYPE AND MODEL: TS-IO-520-E          ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 226193-9-E
ENGINE TOTAL TIME:  213.0 HRS.                        TSMOH:          HRS.
FUEL : 100 OCTANE

                             START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F         91.0    89.5              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.20   30.20              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0160 # H2O/# DRY AIR             TEST START : HOT
RELATIVE HUMIDITY :  53%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW             700  10        1044 .093  584  4.6  9.8 31260   17  40
IDLE/TAXI           1000  16  35.2   466 .075  594  4.4 12.0  4821   44  27
RUN UP              1700  19  49.2   635 .077  942  5.7 11.6  2146  246
RUN UP-L.           1600  20  43.9   585 .075  908  4.7 12.3  1700  150
RUN UP-R.           1550  20  24.6   324 .076  964  5.1 12.1  1580  164
TAKE OFF       FULL 2650  35 105.5  1504 .070 1278  2.2 14.1  1310 1934
CLIMB          75 % 2425  29  84.4  1142 .074 1312  4.2 12.8  1310  812  20
DESCENT        65 % 2350  25  77.4   997 .078 1244  5.9 11.7  1477  261   9
APPROACH       40 % 1900  21  58.0   697 .083 1110  7.7  9.5  2034  155  29
TAXI                1200  16  40.4   483 .084  886  7.6  9.5  7496   48  14


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2     THC      NOX      ALD        CO      CO2     THC      NOX      ALD
                                          (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW        0.52054 1.74266 0.17224 0.00032 0.00048
IDLE/TAXI       0.51692 2.21536 0.02757 0.00085 0.00036    0.30326 1.29968 0.01617 0.00050 0.00020
RUN UP          0.64546 2.06418 0.01183 0.00459            0.52928 1.69263 0.00970 0.00375
RUN UP-L.       0.54290 2.23267 0.00956 0.00285            0.39722 1.63357 0.00699 0.00208
RUN UP-R.       0.58270 2.17248 0.00883 0.00300            0.23891 0.89072 0.00362 0.00123
TAKE OFF        0.26555 2.67452 0.00770 0.03776            0.46693 4.70269 0.01353 0.06639
CLIMB           0.48625 2.32472 0.00738 0.01544 0.00025    0.68400 3.27574 0.01039 0.02173 0.00035
DESCENT         0.65933 2.05463 0.00803 0.00479 0.00011    0.85054 2.65048 0.01036 0.00618 0.00014
APPROACH        0.87751 1.70130 0.01128 0.00290 0.00035    0.84826 1.64459 0.01091 0.00281 0.00034
TAXI            0.84446 1.65877 0.04054 0.00088 0.00017    0.56861 1.11690 0.02730 0.00059 0.00011
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SCOTT RESEARCH LABORATORIES      SRL 1244-314-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-105
                                                           ENGINE  7.PLANE  2


ENGINE TYPE AND MODEL: TS-IO-520-E            ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 226193-9-E
ENGINE TOTAL TIME:  213.0 HRS.                        TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        76.5    77.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.16   30.16               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0156 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  79%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT              PRES  FLOW FLOW  F/A TEMP
                            IN.HG #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW              700  19                .092  605  4.5  8.4 25230   13  29
IDLE/TAXI            1000  17   33.4   431  .078  673  4.6 10.4  7211   47  12
RUN UP               1700  19   51.0   631  .081  953  6.6  9.8  2240  230
RUN UP-L.            1575  20   45.7   579  .079  930  5.8 10.2  1740  127
RUN UP-R.            1550  22   28.1   353  .080  998  6.0 10.0  1740  127
TAKE OFF        FULL 2650  34  126.6  1706  .074       3.8 11.5  1420  999
CLIMB           75 % 2450  28   98.4  1253  .079       5.7 10.3  1475  219   5
DESCENT         65 % 2300  25   87.9  1080  .081       6.7  9.5  1693  169   4
APPROACH        40 % 1900  21   58.0   695  .084       7.5  9.1  2076  144   8
TAXI                 1200  17   36.9   443  .083       7.0  9.1  6555   52  10


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW         0.57865 1.69738 0.15798 0.00027 0.00040
IDLE/TAXI        0.58032 2.06177 0.04428 0.00097 0.00016    0.32305 1.14772 0.02465 0.00054 0.00009
RUN UP           0.78742 1.83730 0.01301 0.00392            0.66931 1.56171 0.01106 0.00333
RUN UP-L.        0.71119 1.96540 0.01043 0.00256            0.54169 1.49698 0.00795 0.00195
RUN UP-R.        0.73571 1.92687 0.01043 0.00256            0.34456 0.90242 0.00489 0.00120
TAKE OFF         0.48806 2.32105 0.00888 0.02108            1.02981 4.89742 0.01873 0.04448
CLIMB            0.70011 1.98803 0.00882 0.00442 0.00007    1.14819 3.26035 0.01446 0.00725 0.00011
DESCENT          0.81178 1.80477 0.00999 0.00336 0.00005    1.18926 2.64399 0.01463 0.00493 0.00008
APPROACH         0.88502 1.68743 0.01192 0.00279 0.00010    0.85552 1.63118 0.01153 0.00270 0.00010
TAXI             0.82858 1.69268 0.03777 0.00101 0.00013    0.50958 1.04100 0.02323 0.00062 0.00008
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-106
                                                         ENGINE  7.PLANE  2


ENGINE TYPE AND MODEL: TS-IO-520-E              ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 286193-9-E
ENGINE TOTAL TIME:  213.8 HRS.                           TSMOH:        HRS.
FUEL : 100 OCTANE

                             START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F         78.0    77.0               FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG      30.14   30.14               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0155 # H20/# DRY AIR          TEST START : HOT
RELATIVE HUMIDITY :  77%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT           PRES   FLOW FLOW  F/A TEMP
                         IN.HG  #/HR #/HR      DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW             700  19              .098  404  5.1   9.1 36416   16  32
IDLE/TAXI           1000  17   33.4   415 .080  583  6.2  10.3  9490   39  26
RUN UP              1700  20   52.7   619 .085  942  8.2   8.9  2538  238
RUN UP-L.           1600  20   49.2   593 .083  897  7.5   9.4  2152   82
RUN UP-R.           1575  21   29.9   381 .079  986  5.8  10.5  1710  120
TAKE OFF       FULL 2650  32  110.8  1564 .071 1256  2.4  12.8  1324 1842
CLIMB          75 % 2450  28  102.0  1330 .077 1244  5.0  11.0  1435  543   6
DESCENT        65 % 2400  27   93.2  1176 .079 1233  6.1  10.4  1490  334   8
APPROACH       40 % 1900  21   59.8   725 .082 1076  7.3   9.6  2842  187   3
TAXI                1200  17   38.7   472 .082  852  7.0   9.8  4414   72   2


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2       THC      NOX      ALD         CO      CO2       THC      NOX      ALD
                                               (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW         0.56693 1.58964 0.19706 0.00029 0.00038
IDLE/TAXI        0.70472 1.83974 0.05251 0.00073 0.00032    0.39229 1.02412 0.02923 0.00041 0.00018
RUN UP           0.93716 1.59840 0.01412 0.00447            0.82314 1.40393 0.01240 0.00392
RUN UP-L.        0.86911 1.71173 0.01214 0.00156            0.71267 1.40362 0.00995 0.00128
RUN UP-R.        0.69940 1.98683 0.01002 0.00253            0.34894 0.99010 0.00499 0.00126
TAKE OFF         0.31045 2.60190 0.00834 0.03914            0.57330 4.80484 0.01540 0.07229
CLIMB            0.61428 2.12366 0.00858 0.01096 0.00008    1.04428 3.61022 0.01459 0.01863 0.00013
DESCENT          0.72667 1.94686 0.00864 0.00654 0.00010    1.12876 3.02413 0.01342 0.01015 0.00016
APPROACH         0.84648 1.74928 0.01153 0.00356 0.00004    0.84366 1.74345 0.01149 0.00355 0.00004
TAXI             0.80523 1.77151 0.02472 0.00136 0.00002    0.51937 1.14262 0.01594 0.00088 0.00002
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171             DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN 2-107
                                                           ENGINE  7.PLANE  3


ENGINE TYPE AND MODEL : TS-IO-520-E              ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 246211-9-E
ENGINE TOTAL TIME:  213.8 HRS.                          TSMOH:        HRS.
FUEL : 100 OCTANE

                           START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F       75.5    75.5                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.14   30.14                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0147 # H20/# DRY AIR             TEST START : COLD
RELATIVE HUMIDITY :  78%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                          IN.HG  #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW              700  18               .116  471   6.6   7.8 58384    15  27
IDLE/TAXI            1000  17   22.9   223 .102  560   8.9   7.9 29646    22   6
RUN UP               1700  20   45.7   497 .092  930  10.3   7.4  3568    54
RUN UP-L.            1600  21   45.7   509 .090  908   9.6   7.8  3184    47
RUN UP-R.            1575  21   43.9   488 .090  964   9.7   7.8  3129    48
TAKE OFF        FULL 2650  32  130.1  1703 .076 1289   4.8  11.0  1757   716
CLIMB           75 % 2450  28  116.0  1344 .086 1267   8.5   8.5  1976   145   5
DESCENT         65 % 2400  27  107.2  1235 .087 1267   8.7   8.4  1976   135  19
APPROACH        40 % 1900  22   59.8   640 .093 1876  10.7   7.1  2745    54  55
TAXI                 1200  17   19.3   200 .096  841   8.9   7.8 16799    34  46

EXHAUST EMISSION MASS DATA :

  TEST     CARR   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE     HEAT
                     CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.64705 1.20166 0.27825 0.00024 0.00028
IDLE/TAXI         0.89310 1.24575 0.14481 0.00036 0.00006   0.34086 0.47546 0.05527 0.00014 0.00002
RUN UP            1.13134 1.27727 0.01908 0.00097           0.86170 0.97295 0.01453 0.00074
RUN UP-L.         1.07459 1.37202 0.01735 0.00086           0.81848 1.04502 0.01321 0.00066
RUN UP-R.         1.08002 1.36474 0.01696 0.00088           0.79022 0.99854 0.01241 0.00064
TAKE OFF          0.59591 2.14597 0.01062 0.01460           1.29212 4.65317 0.02302 0.03166
CLIMB             0.98027 1.54043 0.01109 0.00275 0.00006   1.89519 2.97816 0.02145 0.00531 0.00012
DESCENT           0.99754 1.51358 0.01103 0.00254 0.00023   1.78227 2.70413 0.01971 0.00454 0.00042
APPROACH          1.17412 1.22428 0.01466 0.00097 0.00065   1.17021 1.22020 0.01461 0.00097 0.00064
TAXI              0.96038 1.32264 0.08824 0.00060 0.00053   0.30892 0.42545 0.02838 0.00019 0.00017
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-100
                                                         ENGINE  7.PLANE  3


ENGINE TYPE AND MODEL: TS-IO-520-E            ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 206211-9-E
ENGINE TOTAL TIME:  213.0 HRS.                          TSMOH:        HRS.
FUEL  : 100 OCTANE

                                START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F           75.0    74.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG        30.14   30.14              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0142 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  78%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM   MAN   FUEL  AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES   FLOW FLOW   F/A TEMP
                           IN.HG  #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW               700  19                .141  448  6.0  5.8 79056     9  19
IDLE/TAXI             1000  17   19.3  181 .107  583  8.9  6.6 29317    19   5
RUN UP                1700  19   47.5  514 .092  919 10.0  7.1  3843    52
RUN UP-L.             1600  20   45.7  508 .090  897  9.2  7.5  3514    47
RUN UP-R.             1600  21   45.7  503 .091  964  9.5  7.3  3294    47
TAKE OFF          FULL 2650  31 128.3 1696 .076 1267  4.3 10.8  1867   789
CLIMB             75 % 2450  28 114.3 1368 .084 1278  7.3  8.8  1921   207   8
DESCENT           65 % 2400  27 105.5 1231 .086 1278  8.0  8.4  1921   148  17
APPROACH          40 % 1900  22  58.0  619 .094 1087 10.3  6.8  2855    49  53
TAXI                  1200  17   19.3  201 .096  863  8.6  7.4 15152    37  62

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------     --------------- #/ MIN ---------------
  MODE     HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW           0.65771 0.88155 0.37222 0.00014 0.00020
IDLE/TAXI          0.95768 1.11601 0.15356 0.00034 0.00006     0.30805 0.35898 0.04940 0.00011 0.00002
RUN UP             1.13435 1.26561 0.02122 0.00097             0.89003 1.00194 0.01680 0.00077
RUN UP-L.          1.07010 1.37086 0.01990 0.00090             0.81506 1.04413 0.01515 0.00068
RUN UP-R.          1.09996 1.32822 0.01957 0.00089             0.83780 1.01166 0.01414 0.00068
TAKE OFF           0.55789 2.20191 0.01179 0.01682             1.19296 4.70843 0.02521 0.03596
CLIMB              0.88867 1.68343 0.01138 0.00414 0.00010     1.69292 3.20694 0.02169 0.00789 0.00020
DESCENT            0.95628 1.57786 0.01118 0.00291 0.00022     1.68146 2.77440 0.01965 0.00511 0.00038
APPROACH           1.17502 1.21902 0.01585 0.00092 0.00065     1.13585 1.17839 0.01533 0.00089 0.00063
TAXI               0.97382 1.31676 0.00352 0.00069 0.00075     0.31325 0.42356 0.02687 0.00022 0.00024
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-109
                                                          ENGINE  7.PLANE  3



ENGINE TYPE AND MODEL: TS-IO-520-E            ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 226211-9-E
ENGINE TOTAL TIME:  213.0 HRS.                          TSMOH:        HRS.
FUEL : 100 OCTANE

                         START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F     73.0    73.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG  30.14   30.14                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0142 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  82%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F  %     %     PPMC   PPM PPM

IDLE-LOW                700  18               .092  448  4.5   8.7 25483   18  27
IDLE/TAXI              1000  17   22.9   256 .089  560  5.2   9.1 20567   32  23
RUN UP                 1700  20   47.5   529 .090  930  9.0   8.0  3141   71
RUN UP-L.              1650  20   45.7   519 .088  919  9.1   8.2  2813   58
RUN UP-R.              1625  21   43.9   495 .089  964  9.4   8.1  2704   57
TAKE OFF          FULL 2650  32  128.3  1720 .075 1334  4.1  11.5  1611 1058
CLIMB             75 % 2450  28  114.3  1367 .084 1300  7.7   9.2  1721  207  25
DESCENT           65 % 2400  27  105.5  1233 .086 1278  8.4   8.8  1830  144  29
APPROACH          40 % 1900  21   56.3   598 .094 1076 11.1   7.1  2868   47   8
TAXI                   1200  17   21.1   218 .097  852  8.9   7.8 18273   34  19

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------   ---------------- #/ MIN ---------------
  MODE     HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.56673 1.72177 0.15622 0.00037 0.00036
IDLE/TAXI         0.63053 1.73395 0.12140 0.00064 0.00030    0.24065 0.66179 0.04633 0.00024 0.00011
RUN UP            1.07301 1.37646 0.01674 0.00128            0.84947 1.08970 0.01325 0.00101
RUN UP-L.         1.02656 1.45363 0.01545 0.00107            0.78190 1.10718 0.01177 0.00082
RUN UP-R.         1.04912 1.42062 0.01469 0.00105            0.76761 1.03942 0.01075 0.00076
TAKE OFF          0.51593 2.27406 0.00987 0.02187            1.10324 4.86270 0.02110 0.04677
CLIMB             0.89454 1.67954 0.00973 0.00395 0.00031    1.70410 3.19953 0.01854 0.00753 0.00059
DESCENT           0.95841 1.57779 0.01016 0.00270 0.00035    1.68520 2.77426 0.01787 0.00475 0.00062
APPROACH          1.19085 1.19698 0.01498 0.00083 0.00009    1.11741 1.12317 0.01405 0.00078 0.00009
TAXI              0.95274 1.31212 0.09522 0.00060 0.00022    0.33505 0.46143 0.03349 0.00021 0.00008
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                   RUN P-110
                                                             ENGINE 9.PLANE  1


ENGINE TYPE AND MODEL: O-540-A1B5               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3141-40
ENGINE TOTAL TIME.   1133 HRS.                               TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F         78.0    78.0                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.29   30.29                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0087 # H20/# DRY AIR               TEST START : COLD
RELATIVE HUMIDITY :  43%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW                800  14   22.9  244 .094  639   6.4   7.1 15801     9  23
IDLE/TAXI              1000  14   26.4  307 .086  650   7.1   7.8  7274    21  18
RUN UP                 2000  18   59.8  702 .085  852   8.1   8.8  2870   212
RUN UP-L.              1950  18   56.3  661 .085  729   8.1   8.8  2536   128
RUN UP-R.              1950  18   43.9  515 .085  818   8.1   8.7  2369   127
TAKE OFF          FULL 2650  27  109.0 1275 .086 1400   8.3   8.8  2926   322
CLIMB             75 % 2400  24   91.4 1100 .083 1400   7.6   9.5  2425   350   7
DESCENT           65 % 2300  22   75.6  956 .079 1446   5.9  10.2  2090   899   9
DESCENT    ON     65 % 2300  24   87.9  917 .096 1300  11.4   6.7  3651   155  12
APPROACH          40 % 1900  18   56.3  665 .085 1222   7.7   8.8  2870   265   3
TAXI                   1000  13   26.4  306 .086  796   7.8   8.4  9057    32   9


EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------   --------------- #/ MIN ---------------
  MODE     HEAT
                    CO      CO2      THC      NOX     ALD         CO      CO2      THC      NOX     ALD
                                              (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW          0.84173 1.46739 0.10116 0.00019 0.00032     0.32126 0.56005 0.03861 0.00007 0.00012
IDLE/TAXI         0.90109 1.55560 0.04494 0.00044 0.00024     0.39648 0.68445 0.01977 0.00019 0.00011
RUN UP            0.93472 1.59578 0.01612 0.00402             0.93160 1.59046 0.01607 0.00401
RUN UP-L.         0.93654 1.59889 0.01427 0.00243             0.87878 1.50029 0.01339 0.00228
RUN UP-R.         0.94295 1.59155 0.01342 0.00243             0.68993 1.16448 0.00982 0.00178
TAKE OFF          0.94648 1.57692 0.01624 0.00603             1.71943 2.86473 0.02951 0.01096
CLIMB             0.86916 1.70727 0.01350 0.00658 0.00009     1.32401 2.60074 0.02056 0.01002 0.00013
DESCENT           0.71750 1.94923 0.01237 0.01796 0.00012     0.90405 2.45603 0.01559 0.02263 0.00015
DESCENT    ON     1.22447 1.13087 0.01909 0.00274 0.00014     1.79385 1.65673 0.02797 0.00401 0.00020
APPROACH          0.90973 1.63380 0.01651 0.00514 0.00004     0.85363 1.53305 0.01549 0.00483 0.00004
TAXI              0.90438 1.53048 0.05112 0.00061 0.00011     0.39793 0.67341 0.02249 0.00027 0.00005
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-111
                                                          ENGINE  9.PLANE  1


ENGINE TYPE AND MODEL: O-540-A1B5             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3141-40
ENGINE TOTAL TIME:    1133 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F         86.5    83.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.29   30.29                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0091 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  36%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR  CALC EXH     CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW                800  14   19.3   230 .084          4.2   8.5 11918   13  18
IDLE/TAXI              1000  14   26.4   313 .084   706    6.9   8.5  7449   25  10
RUN UP                 2000  18   59.8   702 .085   986    7.9   8.6  3642  259
RUN UP-L.              1950  18   59.8   703 .085   975    8.0   8.9  3200  149
RUN UP-R.              1950  18   40.4   477 .085   936    7.9   8.8  3035  139
TAKE OFF          FULL 2650  29  110.8  1291 .086  1457    8.3   8.7  3973  283
CLIMB             75 % 2400  24   84.4  1092 .078  1480    5.2  10.3  2593 2026   4
DESCENT           65 % 2300  23   65.0   812 .080  1390    6.1   9.8  2704  851   5
DESCENT     ON    65 % 2300  23   77.4   804 .096  1256   11.4   6.6  4193  157  11
APPROACH          40 % 1900  20   58.0   548 .106  1110   13.7   5.1  6566   34   5
TAXI                   1000  13   26.4   305 .087   796    7.9   8.3  8497   35   8


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW         0.59963 1.90700 0.08283 0.00030 0.00028      0.19288 0.61342 0.02664 0.00010 0.00009
IDLE/TAXI        0.84764 1.64087 0.04454 0.00050 0.00013      0.37296 0.72198 0.01960 0.00022 0.00006
RUN UP           0.92909 1.58935 0.02085 0.00500              0.92599 1.58407 0.02078 0.00499
RUN UP-L.        0.92141 1.61082 0.01794 0.00282              0.91834 1.60545 0.01788 0.00281
RUN UP-R.        0.92148 1.61300 0.01723 0.00266              0.62046 1.08609 0.01160 0.00179
TAKE OFF         0.94622 1.55858 0.02205 0.00530              1.74735 2.87817 0.04072 0.00979
CLIMB            0.65443 2.03700 0.01589 0.04189 0.00005      0.92056 2.86538 0.02235 0.05892 0.00008
DESCENT          0.74818 1.88884 0.01614 0.01715 0.00007      0.81053 2.04625 0.01749 0.01858 0.00007
DESCENT     ON   1.22752 1.11676 0.02198 0.00278 0.00013      1.58350 1.44062 0.02835 0.00358 0.00016
APPROACH         1.39653 0.81695 0.03258 0.00057 0.00005      1.34999 0.78971 0.03150 0.00055 0.00005
TAXI             0.91898 1.51723 0.04812 0.00067 0.00010      0.40435 0.66758 0.02117 0.00029 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-112
                                                           ENGINE 0.PLANE 1


ENGINE TYPE AND MODEL: O-540-A1B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3141-40
ENGINE TOTAL TIME:    1133 HRS.                          TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F.        87.0    85.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      30.29   30.29                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0099 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  30%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH     CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW  FLOW   F/A TEMP
                           IN.HG #/HR  #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW               800  14   22.9   299 .076  516   3.6   9.6   6318    31  14
IDLE/TAXI             1000  13   24.6   299 .082  560   6.2   8.8   6262    38  10
RUN UP                2000  18   58.0   684 .085 1076   7.6   8.5   2897   301
RUN UP-L.             1950  19   61.5   730 .084 1121   7.6   8.7   2400   213
RUN UP-R.             1950  18   40.4   478 .085 1121   7.6   8.5   2345   194
TAKE OFF         FULL 2650  29  114.3  1343 .085 1300   8.0   8.7   2731   368
CLIMB            75 % 2400  24   87.9  1075 .082 1188   6.6   9.2   2400   669   7
DESCENT          65 % 2300  23   75.6   954 .079 1244   5.6   9.7   2179  1067   6
DESCENT     ON   65 % 2300  23   77.4   799 .097 1031  11.1   6.3   3559   238  13
APPROACH         40 % 1900  18   58.0   670 .087 1031   8.1   8.0   2952   281   6
TAXI                  1000  13   26.4   303 .087        7.8   8.0   9076    63   9

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                               (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW          0.51620 2.16313 0.04410 0.00073 0.00022     0.19702 0.82560 0.01683 0.00028 0.00008
IDLE/TAXI         0.78693 1.75517 0.03869 0.00079 0.00014     0.32264 0.71962 0.01586 0.00032 0.00006
RUN UP            0.91968 1.61636 0.01707 0.00598             0.88903 1.56248 0.01650 0.00578
RUN UP-L.         0.91133 1.63936 0.01401 0.00420             0.93411 1.68034 0.01436 0.00430
RUN UP-R.         0.92279 1.62182 0.01386 0.00387             0.62135 1.09203 0.00933 0.00261
TAKE OFF          0.93481 1.59753 0.01553 0.00706             1.78082 3.04329 0.02959 0.01346
CLIMB             0.81608 1.78761 0.01445 0.01359 0.00009     1.19556 2.61885 0.02116 0.01991 0.00014
DESCENT           0.71573 1.94818 0.01356 0.02240 0.00008     0.90182 2.45471 0.01708 0.02823 0.00010
DESCENT    ON     1.23987 1.10583 0.01935 0.00437 0.00016     1.59943 1.42652 0.02496 0.00563 0.00020
APPROACH          0.97986 1.52077 0.01738 0.00558 0.00008     0.94720 1.47008 0.01680 0.00540 0.00008
TAXI              0.92593 1.49233 0.05245 0.00123 0.00011     0.40741 0.65663 0.02308 0.00054 0.00005
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-113
                                                       ENGINE  9.PLANE  2


ENGINE TYPE AND MODEL: O-540-A1B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3454-40
ENGINE TOTAL TIME:    932 HRS.                           TSMOH:    932 HRS.
FUEL : 140 OCTANE

                           START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       70.0    74.0               FLOW RATE   7 LPM
ATMOSPHERIC PRES.-IN.HG   30.28   30.28               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0094 # H20/# DRY AIR           TEST START : COLD
RELATIVE HUMIDITY :  57%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM   MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR      DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW               800   13   21.1  224 .094  706  6.2   8.9 26715   15  14
IDLE/TAXI             1000   13   24.6  289 .085  773  5.7   9.4 11819   38  10
RUN UP                2000   16   52.7  641 .082 1278  7.1   9.7  5991  249
RUN UP-L.             1900   17   47.5  587 .081 1334  6.5  10.0  4695  152
RUN UP-R.             1950   17   52.7  654 .081 1312  6.5  10.2  4372  109
TAKE OFF        FULL  2650   28  110.8 1207 .092 1379 10.8   9.6 10200  276
CLIMB           75 %  2400   24  110.8 1279 .087 1424  8.9   8.9  6638  171   4
DESCENT         65 %  2300   23   77.4 1032 .075 1558  4.2  12.0  4857 1356   7
DESCENT     ON  65 %  2300   23   84.4  820 .102 1278 12.3   6.8 10524  117   7
APPROACH        40 %  1900   18   58.0  700 .083       7.3   9.6  6962  247   6
TAXI                  1000   12   22.9  271 .084       5.7   9.7 11496   46   9

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     --------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                             (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.69193 1.56083 0.14513 0.00028 0.00017     0.24333 0.54889 0.05104 0.00010 0.00006
IDLE/TAXI        0.69433 1.79934 0.07008 0.00075 0.00013     0.28468 0.73773 0.02873 0.00031 0.00005
RUN UP           0.80933 1.73754 0.03324 0.00391             0.71886 1.52614 0.02920 0.00344
RUN UP-L.        0.75970 1.83663 0.02671 0.00292             0.60143 1.45400 0.02115 0.00231
RUN UP-R.        0.75226 1.85503 0.02463 0.00207             0.66074 1.62933 0.02163 0.00182
TAKE OFF         1.00010 1.39683 0.04597 0.00420             1.84667 2.57947 0.08490 0.00775
CLIMB            0.95601 1.50231 0.03471 0.00302 0.00005     1.76544 2.77425 0.06410 0.00557 0.00009
DESCENT          0.49923 2.24144 0.02810 0.02648 0.00009     0.64401 2.89146 0.03625 0.03416 0.00012
DESCENT    ON    1.21053 1.05165 0.05842 0.00189 0.00007     1.70281 1.47933 0.07092 0.00266 0.00010
APPROACH         0.82281 1.70037 0.03820 0.00457 0.00007     0.79538 1.64369 0.03693 0.00442 0.00007
TAXI             0.68310 1.82673 0.06706 0.00091 0.00012     0.26072 0.69720 0.02560 0.00035 0.00004
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-114
                                                          ENGINE  9.PLANE  2


ENGINE TYPE AND MODEL: 0-540-A1B5              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3454-40
ENGINE TOTAL TIME:     932 HRS.                         TSMOH:     932 HRS.
FUEL : 100 OCTANE

                            START  FINISH               SAMPLE LINE :
INLET AIR TEMP.-DEG.F        75.5    78.5                 FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.28   30.28                 TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0097 # H20/# DRY AIR               TEST START : HOT
RELATIVE HUMIDITY :  50%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT              PRES  FLOW  FLOW  F/A  TEMP
                            IN.HG #/HR  #/HR       DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW                800  13   22.9   279 .082  493   2.1   8.3 14808    18   11
IDLE/TAXI              1000  12   22.9   295 .077  684   4.6  10.1  4177    42    7
RUN UP                 2000  17   52.7   640 .082 1233   7.5   9.8  2549   193
RUN UP-L.              1900  18   47.5   580 .082 1267   7.2   9.9  1844   145
RUN UP-R.              1950  17   52.7   487 .108 1099   3.5   6.7 41984    87
TAKE OFF          FULL 2600  28  109.0  1262 .086 1278   9.3   9.2  1898   208
CLIMB             75 % 2400  25   80.9  1067 .076 1076   4.8  11.7  1193  1076    4
DESCENT           65 % 2300  22   70.3   935 .075 1211   4.6  11.9  1410  1184    9
DESCENT      ON   65 % 2300  23   72.1   741 .097 1143  12.2   6.7  3634   117    5
APPROACH          40 % 1900  18   52.7   625 .084 1166   8.0   9.1  2115   222    4
TAXI                   1000  12   24.6   312 .079  919   5.2   9.7  3905    59    7

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ---------------
  MODE    HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                               (NO2)    (HCHO)                                 (NO2)    (HCHO)

IDLE-LOW          0.35057 2.17732 0.12033 0.00049 0.00020      0.13380 0.83101 0.04593 0.00019 0.00008
IDLE/TAXI         0.60349 2.08222 0.02668 0.00091 0.00010      0.23033 0.79471 0.01018 0.00035 0.00004
RUN UP            0.84734 1.73988 0.01402 0.00358              0.74425 1.52819 0.01231 0.00315
RUN UP-L.         0.82618 1.78514 0.01030 0.00273              0.65406 1.41323 0.00815 0.00216
RUN UP-R.         0.48211 1.45028 0.28152 0.00197              0.42346 1.27383 0.24726 0.00173
TAKE OFF          0.98690 1.53417 0.00980 0.00363              1.79287 2.78708 0.01781 0.00659
CLIMB             0.57283 2.19414 0.00693 0.02110 0.00005      0.77236 2.95843 0.00934 0.02844 0.00007
DESCENT           0.54824 2.22873 0.00818 0.02318 0.00011      0.64235 2.61133 0.00958 0.02716 0.00013
DESCENT     ON    1.25610 1.08401 0.01821 0.00198 0.00006      1.50941 1.30262 0.02189 0.00238 0.00007
APPROACH          0.91654 1.63831 0.01180 0.00418 0.00005      0.80503 1.43899 0.01036 0.00367 0.00004
TAXI              0.67449 1.97715 0.02466 0.00126 0.00010      0.27654 0.81063 0.01011 0.00052 0.00004
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-115
                                                       ENGINE  9,PLANE  2


ENGINE TYPE AND MODEL: O-540-A1B5            ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-3454-40
ENGINE TOTAL TIME:     932 HRS.                     TSMOH:     932 HRS.
FUEL : 100 OCTANE

                         START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F     87.0    84.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG  30.29   30.29                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0097 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  38%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM   MAN  FUEL AIR  CALC EXH    CO  CO2    THC    NO  ALD
  MODE    HEAT            PRES FLOW FLOW  F/A TEMP
                          IN.HG #/HR #/HR     DEG.F  %    %     PPMC   PPM PPM

IDLE-LOW               800  12  22.9  290 .079  639  4.7  9.3  5742    34  10
IDLE/TAXI             1000  12  24.6  320 .077  751  4.2  9.6  3137    53   8
RUN UP                2000  17  56.3  678 .083 1300  7.3  9.2  1914   172
RUN UP-L.             1975  17  49.2  596 .083 1233  7.2  9.3  1755   138
RUN UP-R.             1800  17  52.7  479 .110  953  4.3  6.0 38281    59
TAKE OFF         FULL 2600  18 110.8 1380 .080 1412  5.8  9.4  1489   197
CLIMB            75 % 2400  28 109.0 1253 .087 1323  8.8  8.5  2020  1478   9
DESCENT          65 % 2300  23  70.3  935 .075 1412  4.3 11.3  1329  1232   5
DESCENT          65 % 2300  23  79.1  812 .097 1233 11.8  6.4  3084   131   5
APPROACH         40 % 1900  17  51.0  606 .084 1166  7.7  9.0  2020   182   5
TAXI                  1000  12  29.9  401 .075  684  3.7 10.9  2605    94   5

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                           (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW        0.63960 1.98874 0.03804 0.00076 0.00015    0.24411 0.75905 0.01452 0.00029 0.00006
IDLE/TAXI       0.59021 2.11993 0.02146 0.00122 0.00012    0.24198 0.86917 0.00880 0.00050 0.00005
RUN UP          0.86741 1.71785 0.01107 0.00336            0.81392 1.61192 0.01039 0.00315
RUN UP-L.       0.85635 1.73818 0.01016 0.00270            0.70220 1.42531 0.00833 0.00221
RUN UP-R.       0.60364 1.32360 0.26160 0.00136            0.53020 1.16256 0.22977 0.00120
TAKE OFF        0.74946 1.90871 0.00937 0.00418            1.38400 3.52476 0.01730 0.00772
CLIMB           0.99722 1.51364 0.01114 0.02752 0.00011    1.81162 2.74977 0.02024 0.04999 0.00020
DESCENT         0.54237 2.23852 0.00816 0.02552 0.00007    0.63513 2.62274 0.00956 0.02990 0.00008
DESCENT         1.26447 1.07771 0.01609 0.00231 0.00006    1.66699 1.42078 0.02121 0.00304 0.00008
APPROACH        0.90354 1.65957 0.01154 0.00351 0.00006    0.76801 1.41063 0.00981 0.00298 0.00005
TAXI            0.49381 2.28604 0.01692 0.00206 0.00007    0.24608 1.13921 0.00843 0.00103 0.00004
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-116
                                                       ENGINE  5.PLANE  3


ENGINE TYPE AND MODEL: IO-470-VO            ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 149063VO
ENGINE TOTAL TIME:  184.7 HRS.                      TSMOH:        HRS.
FUEL : 100 OCTANE

                           START  FINISH         SAMPLE LINE :
INLET AIR TEMP.-DEG.F       89.5    90.0           FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.06   30.06           TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0136 # H20/# DRY AIR        TEST START : HOT
RELATIVE HUMIDITY :  46%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN. FUEL AIR  CALC EXH   CO  CO2   THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %   PPMC  PPM PPM

IDLE-LOW              700  17  19.3  232 .083  673  3.5  8.0 11981   15  21
IDLE/TAXI            1000  16  26.4  359 .073  874  3.0 10.5  2105   37  12
RUN UP               1700  18  47.5  601 .079 1199  5.7 10.2  2051  167
RUN UP-L.            1600  19  24.6  331 .074 1256  3.8 11.0  1079  120
RUN UP-R.            1600  19  51.0  689 .074 1233  3.6 11.0  1187  108
TAKE OFF        FULL 2650  29  96.7 1240 .078       5.3 10.9  3454  688
CLIMB           75 % 2450  24  77.4  988 .078       5.6 10.6  1943  589   0
DESCENT         65 % 2300  22  70.3  880 .080 1356  6.3 10.2  2159  454   0
APPROACH        40 % 2100  20  59.8  713 .084 1278  7.7  9.2  2375  216   0
TAXI                 1000  16  24.6  321 .077  886  4.6 10.5  2591   55   6

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD           CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                  (NO2)    (HCHO)

IDLE-LOW          0.54667 1.96355 0.09109 0.00038 0.00035      0.17585 0.63161 0.02930 0.00012 0.00011
IDLE/TAXI         0.43397 2.38686 0.01482 0.00088 0.00019      0.19095 1.05022 0.00652 0.00039 0.00008
RUN UP            0.70195 1.97391 0.01230 0.00338              0.55571 1.56266 0.00973 0.00267
RUN UP-L.         0.50555 2.29968 0.00699 0.00262              0.20727 0.94287 0.00286 0.00108
RUN UP-R.         0.48510 2.32924 0.00779 0.00239              0.41233 1.97985 0.00662 0.00203
TAKE OFF          0.63532 2.05324 0.02015 0.01355              1.02393 3.30914 0.03248 0.02184
CLIMB             0.67747 2.01513 0.01144 0.01171 0.00010      0.87394 2.59952 0.01476 0.01510 0.00013
DESCENT           0.74749 1.90178 0.01247 0.00885 0.00010      0.87581 2.22825 0.01461 0.01037 0.00012
APPROACH          0.89113 1.67313 0.01338 0.00411 0.00010      0.88816 1.66756 0.01334 0.00409 0.00010
TAXI              0.59400 2.13066 0.01629 0.00117 0.00008      0.24354 0.87357 0.00668 0.00048 0.00003
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-117
                                                        ENGINE  5.PLANE  3


ENGINE TYPE AND MODEL : IO-470-VO                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 149063VO
ENGINE TOTAL TIME:     185 HRS.                          TSMOH:        HRS.
FUEL : 100 OCTANE

                              START  FINISH         SAMPLE LINE :
INLET AIR TEMP.-DEG.F          89.0   90.5            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.06  30.06            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0134 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  45%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F  %    %     PPMC  PPM PPM

IDLE-LOW             700  16  21.1  222 .095  685  4.9  7.6 25132   15  25
IDLE/TAXI           1000  16  26.4  343 .077  863  4.5 10.6  4726   52  10
RUN UP              1700  18  49.2  617 .080  975  6.3 10.4  2309  259
RUN UP-L.           1600  19  26.4  341 .077 1043  5.3 11.1  1879  157
RUN UP-R.           1600  19  49.2  643 .077  976  5.1 11.3  1718  162
TAKE OFF       FULL 2652  28 123.1 1571 .078 1256  5.6 14.9  4726  679
CLIMB          75 % 2450  24  94.9 1200 .079 1233  6.0 14.5  2148  314   0
DESCENT        65 % 2300  22  77.4  931 .083 1177  7.6  9.5  2148  226  13
APPROACH       40 % 2100  20  63.3  742 .085 1076  8.4  9.0  2524  231   6
TAXI                1000  16  24.6  247 .099  314  7.0  7.6 27065   42  27


EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO       CO2      THC      NOX      ALD         CO       CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          0.64732 1.57772 0.16162 0.00033 0.00035      0.22764 0.55403 0.05684 0.00011 0.00012
IDLE/TAXI         0.57312 2.12146 0.02930 0.00109 0.00025      0.25217 0.93344 0.01289 0.00044 0.00011
RUN UP            0.73800 1.91445 0.01317 0.00498              0.60516 1.56405 0.01000 0.00439
RUN UP-L.         0.63369 2.00556 0.01094 0.00308              0.27003 0.91744 0.00481 0.00136
RUN UP-R.         0.61037 2.12520 0.01001 0.00319              0.50251 1.74266 0.00621 0.00261
TAKE OFF          0.65439 2.00156 0.02600 0.01304              1.34259 4.10653 0.05516 0.02674
CLIMB             0.71194 1.95785 0.01241 0.00612 0.00010      1.12606 3.09666 0.01962 0.00954 0.00016
DESCENT           0.87055 1.71030 0.01198 0.00425 0.00016      1.12300 2.20592 0.01545 0.00549 0.00021
APPROACH          0.94378 1.59902 0.01380 0.00426 0.00007      0.99569 1.67642 0.01456 0.00450 0.00008
TAXI              0.80220 1.36866 0.15098 0.00079 0.00033      0.32490 0.56115 0.06190 0.00032 0.00014
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-110
                                                        ENGINE  5.PLANE  3


ENGINE TYPE AND MODEL: IO-470-VO                ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 149063VO
ENGINE TOTAL TIME:     185 HRS.                          TSMOH:        HRS.
FUEL : 100 OCTANE

                              START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F          81.5    83.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.04   30.04              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0144 # H20/# DRY AIR              TEST START : COLD
RELATIVE HUMIDITY :  61%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH   CO  CO2   THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F  %    %   PPMC  PPM PPM

IDLE-LOW               700  16  21.1  218 .097        6.4  7.9 25132   25  31
IDLE/TAXI             1000  16  24.6  328 .075        3.8 11.4  5263  177  15
RUN UP                1700  18  49.2  615 .080        6.0  9.8  2792  225
RUN UP-L.             1600  19  29.9  386 .077        5.0 10.5  2578  168
RUN UP-R.             1650  19  49.2  643 .077        4.7 10.7  2255  158
TAKE OFF         FULL 2650  28 107.2 1354 .079        5.7 10.1  3437  148
CLIMB            75 % 2450  24  80.9 1038 .078        5.4 10.5  1987  309   3
DESCENT          65 % 2300  22  68.6  839 .082        6.9  9.5  2148  202   6
APPROACH         40 % 2100  21  59.8  704 .085        8.0  8.8  2685  202   2
TAXI                  1000  16  24.6  245 .100        7.8  7.5 25776   27  24


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    --------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW        0.75496 1.46442 0.14431 0.00048 0.00039      0.26550 0.51499 0.05075 0.00017 0.00014
IDLE/TAXI       0.47924 2.25927 0.03231 0.00367 0.00020      0.19649 0.92630 0.01325 0.00150 0.00008
RUN UP          0.74009 1.89956 0.01676 0.00458              0.60687 1.55764 0.01375 0.00376
RUN UP-L.       0.62932 2.07675 0.01580 0.00347              0.31361 1.03491 0.00787 0.00173
RUN UP-R.       0.59657 2.13423 0.01393 0.00329              0.48919 1.75005 0.01143 0.00270
TAKE OFF        0.70027 1.94988 0.02055 0.00299              1.25115 3.48374 0.03672 0.00534
CLIMB           0.66527 2.03277 0.01192 0.00625 0.00004      0.89701 2.74046 0.01607 0.00843 0.00005
DESCENT         0.81664 1.79284 0.01256 0.00399 0.00008      0.93369 2.04981 0.01436 0.00456 0.00009
APPROACH        0.92959 1.60686 0.01519 0.00386 0.00002      0.92649 1.60150 0.01514 0.00384 0.00002
TAXI            0.86533 1.30750 0.13920 0.00049 0.00029      0.35478 0.53608 0.05707 0.00020 0.00012
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES               RUN 0-119
                                                         ENGINE  5.PLANE  4


ENGINE TYPE AND MODEL: IO 470-VO              ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 49055VO
ENGINE TOTAL TIME:     185 HRS.                        TSMOH:          HRS.
FUEL : 100 OCTANE

                          START  FINISH            SAMPLE LINE :
INLET AIR TEMP.-DEG.F      86.0    86.0              FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG   30.04   30.04              TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0152 # H20/# DRY AIR          TEST START : COLD
RELATIVE HUMIDITY :  57%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %     %     PPMC   PPM PPM

IDLE-LOW              700  17   10.5   102 .103  482   4.8   7.0 34824    78  60
IDLE/TAXI            1000  16   17.6   199 .088  762   7.4   8.9 10577    53  29
RUN UP               1700  19   31.6   401 .079 1199   5.8  10.4  2549   249
RUN UP-L.            1650  20   29.9   396 .076 1256   4.6  11.5  1519   176
RUN UP-R.            1600  20   31.5   420 .075 1222   4.5  11.5  2061   197
TAKE OFF        FULL 2650  28  110.8  1405 .079 1446   5.7  10.7  5370   539
CLIMB           75 % 2450  24   80.9  1027 .079 1400   5.8  10.2  2115   373   6
DESCENT         65 % 2300  23   70.3   850 .083        7.7   9.8  2224   192   4
APPROACH        40 % 2100  21   51.0   590 .085        8.5   9.1  2270   171  10
TAXI                 1000  16   14.1   136 .104        8.9   7.4 28640    21  44


EXHAUST EMISSION MASS DATA :

  TEST    CARB  ---------------- #/# FUEL ----------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                   CO       CO2       THC       NOX      ALD          CO       CO2       THC       NOX      ALD
                                                (NO2)   (HCHO)                                   (NO2)   (HCHO)

IDLE-LOW         0.62294 1.42757 0.22000 0.00166 0.00083      0.10301 0.24902 0.03850 0.00029 0.00015
IDLE/TAXI        0.84554 1.59404 0.05003 0.00099 0.00036      0.24893 0.46876 0.01726 0.00029 0.00010
RUN UP           0.69908 1.96903 0.01496 0.00493              0.36819 1.03744 0.00788 0.00260
RUN UP-L.        0.56137 2.20538 0.00902 0.00353              0.27975 1.09902 0.00450 0.00176
RUN UP-R.        0.55072 2.21162 0.01228 0.00396              0.29005 1.16478 0.00647 0.00209
TAKE OFF         0.66747 1.96896 0.03061 0.01037              1.23264 3.63502 0.05653 0.01915
CLIMB            0.70958 1.96095 0.01260 0.00750 0.00008      0.95675 2.64442 0.01698 0.01011 0.00011
DESCENT          0.86172 1.72343 0.01212 0.00353 0.00005      1.00964 2.21927 0.01420 0.00414 0.00006
APPROACH         0.94562 1.59007 0.01234 0.00313 0.00012      0.80378 1.35224 0.01049 0.00266 0.00010
TAXI             0.92100 1.20347 0.14420 0.00036 0.00049      0.21645 0.28282 0.03391 0.00008 0.00011
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-120
                                                           ENGINE  S.PLANE  4


ENGINE TYPE AND MODEL: IO 470-VO                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 49055VO
ENGINE TOTAL TIME:     105 HRS.                           (SMOH:          HRS.
FUEL : 100 OCTANE

                               START  FINISH           SAMPLE LINE :
INLET AIR TEMP.-DEG.F           90.0    90.0             FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG        30.05   30.04             TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0166 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY :  55%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT           PRES  FLOW FLOW  F/A TEMP
                         IN.HG #/HR #/HR      DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW             700  16   10.5   96 .110  482   3.5   6.9 46144   185  40
IDLE/TAXI           1000  16   15.8  175 .090  762   7.6   8.8 13358    36  29
RUN UP              1700  18   33.4  384 .087 1099   8.7   8.5  4129    68
RUN UP-L.           1550  19   26.4  323 .082 1121   6.9   9.7  3373    73
RUN UP-R.           1600  18   31.6  383 .083 1143   7.2   9.5  3373    68
TAKE OFF       FULL 2650  28   98.4 1241 .079 1412   6.0  10.6  5478   473
CLIMB          75 % 2450  24   77.4  967 .080 1435   6.4  10.3  2294   263   8
DESCENT        65 % 2300  22   63.3  756 .084 1334   7.0   9.3  2294   200   5
APPROACH       40 % 2100  21   51.0  592 .086 1256   8.5   8.7  2402   146   3
TAXI                1000  16   15.8  146 .109  471   8.4   6.8 34811    19  45


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                   CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                             (NO2)   (HCHO)                                (NO2)   (HCHO)

IDLE-LOW         0.46233 1.43229 0.29672 0.00401 0.00057     0.08091 0.25065 0.05193 0.00070 0.00010
IDLE/TAXI        0.84988 1.54640 0.07272 0.00066 0.00035     0.22380 0.40722 0.01915 0.00017 0.00009
RUN UP           0.97968 1.59411 0.02263 0.00126             0.54536 0.83729 0.01260 0.00070
RUN UP-L.        0.88798 1.70492 0.01923 0.00140             0.35551 0.78536 0.00846 0.00062
RUN UP-R.        0.83816 1.73785 0.01911 0.00130             0.44143 0.91527 0.01007 0.00068
TAKE OFF         0.69397 1.92658 0.03084 0.00849             1.13811 3.15940 0.05058 0.01474
CLIMB            0.74970 1.89621 0.01308 0.00506 0.00010     0.96722 2.44611 0.01690 0.00653 0.00013
DESCENT          0.89270 1.67259 0.01278 0.00376 0.00006     0.94180 1.76458 0.01348 0.00397 0.00006
APPROACH         0.96664 1.55474 0.01330 0.00273 0.00004     0.82164 1.32153 0.01130 0.00232 0.00003
TAXI             0.89181 1.13448 0.17991 0.00033 0.00051     0.23484 0.29875 0.04738 0.00009 0.00013
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171             DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                    RUN P-121
                                                             ENGINE  5.PLANE  4


ENGINE TYPE AND MODEL: IO 470-VO               ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 49255VO
ENGINE TOTAL TIME:     185 HRS.                         TSMOH:         HRS.
FUEL : 100 OCTANE

                            START  FINISH              SAMPLE LINE :
INLET AIR TEMP.-DEG.F        77.5    78.0                FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     30.04   30.04                TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0166 # H20/# DRY AIR              TEST START : HOT
RELATIVE HUMIDITY : 75%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM  MAN  FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT           PRES FLOW FLOW  F/A TEMP
                        IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW              700  18  12.3  141 .087        1.3  6.7 19332   27  32
IDLE/TAXI            1000  17  15.8  213 .074        3.5 11.1  3974   63  15
RUN UP               1700  18  33.4  397 .084        7.8  9.1  3007  114
RUN UP-L.            1550  19  26.4  330 .080        6.2 10.1  2792   96
RUN UP-R.            1600  18  28.1  349 .081        6.5 10.0  2363   90
TAKE OFF       FULL  2650  28 102.0 1282 .080 1569   6.1 10.6  5692  497
CLIMB          75 %  2450  24  72.1  888 .081 1424   6.8 10.0  2470  215  13
DESCENT        65 %  2300  22  63.3  749 .084 1368   8.0  9.1  2470  167  21
APPROACH       40 %  2100  21  49.2  579 .085 1300   8.2  9.0  2578  160  19
TAXI                 1000  16  15.8  198 .080  762   3.8 10.5 11116   50  15

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------     --------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW         0.25957 2.10221 0.18790 0.00089 0.00068     0.05321 0.43095 0.03852 0.00018 0.00014
IDLE/TAXI        0.46286 2.30673 0.02558 0.00137 0.00021     0.12189 0.60744 0.00674 0.00036 0.00006
RUN UP           0.89938 1.64887 0.01688 0.00216             0.50066 0.91787 0.00940 0.00120
RUN UP-L.        0.74169 1.89866 0.01626 0.00189             0.32634 0.83541 0.00715 0.00083
RUN UP-R.        0.77028 1.86222 0.01363 0.00175             0.36075 0.87214 0.00638 0.00082
TAKE OFF         0.70057 1.91304 0.03182 0.00938             1.19097 3.25217 0.05410 0.01594
CLIMB            0.79115 1.82828 0.01399 0.00411 0.00016     0.95069 2.19698 0.01681 0.00494 0.00019
DESCENT          0.91466 1.63496 0.01375 0.00314 0.00026     0.96497 1.72488 0.01450 0.00331 0.00027
APPROACH         0.93158 1.60673 0.01426 0.00299 0.00023     0.76390 1.31752 0.01169 0.00245 0.00019
TAXI             0.48903 2.12340 0.06964 0.00106 0.00021     0.12878 0.55915 0.01834 0.00028 0.00005
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SCOTT RESEARCH LABORATORIES   SRL 1244-014-1171   DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES   RUN P-122
ENGINE 1.PLANE 12

ENGINE TYPE AND MODEL: O-320-B3B   ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4393-39
ENGINE TOTAL TIME: 563 HRS.   TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	84.0	77.0
ATMOSPHERIC PRES.-IN.HG	29.80	29.80

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0175 # H20/# DRY AIR
RELATIVE HUMIDITY : 78%

TEST START : COLD

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800	10	15.2	176	.086	168	1.7	2.6	4168		5
IDLE/TAXI			1000	10	19.9	247	.081	191	1.7	3.1	1924		4
RUN UP			1700	13	32.8	479	.068	426	0.5	6.2	962		
RUN UP-L.			1550	14	16.4	246	.067	426	0.1	5.0	321		
RUN UP-R.			1600	14	30.5	431	.071	415	0.6	5.0	1817		
TAKE OFF		FULL	2500	28	50.4	541	.093	830	7.6	5.3	3206		
CLIMB		FULL	2400	24	45.7	548	.083	740	6.2	7.7	2992		6
DESCENT		65 %	2300	23	42.2	502	.084	695	6.2	7.5	2939		8
DESCENT	ON	65 %	2300	23	42.2	432	.098	594	8.9	4.9	4061		10
APPROACH		40 %	1900	17	36.3	385	.094	516	6.5	4.3	3206		6
TAXI			1000	10	17.6	233	.075	269	0.9	3.4	2298		4

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.71482	1.71797	0.08531		0.00023	0.18109	0.43522	0.02161		0.00006
IDLE/TAXI		0.67536	1.93527	0.03721		0.00017	0.22399	0.64187	0.01234		0.00006
RUN UP		0.14591	2.84326	0.01367			0.07977	1.55431	0.00747		
RUN UP-L.		0.03865	3.03644	0.00604			0.01056	0.82996	0.00165		
RUN UP-R.		0.20582	2.69529	0.03034			0.10463	1.37010	0.01542		
TAKE OFF		1.14014	1.24944	0.02341			0.95772	1.04953	0.01967		
CLIMB		0.86601	1.69012	0.02034		0.00009	0.65961	1.28731	0.01550		0.00007
DESCENT		0.87872	1.67037	0.02028		0.00012	0.61803	1.17483	0.01426		0.00009
DESCENT	ON	1.24254	1.07501	0.02760		0.00015	0.87392	0.75609	0.01941		0.00011
APPROACH		1.15926	1.20512	0.02783		0.00011	0.70135	0.72910	0.01684		0.00007
TAXI		0.39406	2.33932	0.04898		0.00019	0.11559	0.68620	0.01437		0.00006

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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-123
                                                        ENGINE  1.PLANE 12


ENGINE TYPE AND MODEL: 0-320-B3B               ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4393-39
ENGINE TOTAL TIME:     563 HRS.                        TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F         76.5    72.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.80   29.80            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0173 # H20/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  94%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL  AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES   FLOW  FLOW   F/A TEMP
                          IN.HG  #/HR  #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              800   10   16.4   197 .083  381  2.6   6.4 10368          5
IDLE/TAXI            1000   10   19.9   261 .076  549  3.5   9.0  3615          4
RUN UP               1700   13   32.8   370 .089  863  8.6   7.5  3350
RUN UP-L.            1550   14   15.2   172 .088  942  8.2   7.3  3190
RUN UP-R.            1600   13   31.6   356 .089  863  8.2   7.2  3562
TAKE OFF        FULL 2500   28   50.4   544 .093 1177 10.7   7.4  3722
CLIMB           FULL 2400   24   45.7   524 .087 1289  9.0   8.6  3296          6
DESCENT         65 % 2300   23   44.5   535 .083 1300  7.6   9.5  3296          5
DESCENT    ON   65 % 2300   23   43.4   444 .098 1121 12.5   6.7  4466         17
APPROACH        40 % 1900   20   36.3   414 .088 1087  9.1   8.4  3084          8
TAXI                 1000   10   18.8   250 .075  549  2.8   8.3  3084          5

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2       THC       NOX      ALD          CO      CO2      THC       NOX      ALD
                                              (NO2)    (HCHO)                                  (NO2)    (HCHO)

IDLE-LOW          0.51378 1.98735 0.09973           0.00011      0.14043 0.54321 0.02726            0.00003
IDLE/TAXI         0.53972 2.18093 0.02714           0.00007      0.17901 0.72334 0.00900            0.00002
RUN UP            1.03783 1.42227 0.01968                        0.56734 0.77751 0.01076
RUN UP-L.         1.02809 1.43825 0.01947                        0.26045 0.36436 0.00493
RUN UP-R.         1.03219 1.42420 0.02193                        0.54362 0.75008 0.01150
TAKE OFF          1.14844 1.24854 0.01945                        0.96503 1.04878 0.01634
CLIMB             0.99556 1.49492 0.01775           0.00007      0.75829 1.13863 0.01352            0.00005
DESCENT           0.86481 1.69874 0.01826           0.00006      0.64140 1.25990 0.01354            0.00005
DESCENT    ON     1.26188 1.06286 0.02195           0.00018      0.91276 0.76881 0.01587            0.00013
APPROACH          1.01347 1.47009 0.01672           0.00010      0.61315 0.88941 0.01012            0.00006
TAXI              0.48678 2.26748 0.02610           0.00009      0.15252 0.71040 0.00818            0.00003
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-124
                                                        ENGINE  1.PLANE 12


ENGINE TYPE AND MODEL: 0-320-B3B             ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4393-39
ENGINE TOTAL TIME:     563 HRS.                       TSMOH:        HRS.
FUEL : 100 OCTANE

                           START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F       66.0    68.0            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    29.97   29.97            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0071 # H20/# DRY AIR         TEST START : HOT
RELATIVE HUMIDITY :  51%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST    CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO  CO2    THC   NO  ALD
  MODE    HEAT              PRES  FLOW FLOW  F/A TEMP
                            IN.HG #/HR #/HR      DEG.F  %    %    PPMC  PPM PPM

IDLE-LOW                800  10  14.1  149 .094  336  7.5  6.9 12244   18   7
IDLE/TAXI              1000  10  19.9  222 .090  527  9.7  8.0  5424   48   3
RUN UP                 1700  13  38.7  449 .086  807  7.9  8.0  2792  137
RUN UP-L.              1550  14  21.1  247 .086  852  7.6  8.1  2631  131
RUN UP-R.              1600  13  38.7  453 .085  807  7.5  8.0  2578  106
TAKE OFF          FULL 2500  28  73.8  905 .082 1278  6.5  9.3  3007  411
CLIMB             FULL 2400  24  59.8  770 .078 1300  5.2 10.6  2579  944
DESCENT           65 % 2300  23  55.1  697 .079 1278  5.8 10.3  2631  737   3
DESCENT      ON   65 % 2300  23  56.3  580 .097 1076 11.9  6.7  3974  175   3
APPROACH          40 % 1900  20  43.4  500 .087 1076  8.8  8.5  2631  296   2
TAXI                   1000   9  19.9  246 .081  482  5.9  9.1  3437  100   3

EXHAUST EMISSION MASS DATA :

  TEST    CARB   --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                    CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                             (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE-LOW         0.95204 1.37637 0.07566 0.00038 0.00010      0.22373 0.32345 0.01778 0.00009 0.00002
IDLE/TAXI        1.05459 1.36678 0.02871 0.00086 0.00003      0.34977 0.45332 0.00952 0.00028 0.00001
RUN UP           0.96842 1.54107 0.01666 0.00276              0.62463 0.99399 0.01075 0.00178
RUN UP-L.        0.94426 1.58146 0.01591 0.00206              0.33207 0.55615 0.00560 0.00072
RUN UP-R.        0.94398 1.58229 0.01580 0.00219              0.60887 1.02057 0.01019 0.00141
TAKE OFF         0.80069 1.80023 0.01803 0.00832              0.98485 2.21429 0.02218 0.01023
CLIMB            0.64226 2.05736 0.01550 0.01915              0.64012 2.05058 0.01545 0.01909
DESCENT          0.70300 1.96183 0.01552 0.01468 0.00004      0.64559 1.80162 0.01426 0.01348 0.00004
DESCENT     ON   1.24236 1.09919 0.02020 0.00300 0.00003      1.16575 1.03140 0.01895 0.00282 0.00003
APPROACH         0.99375 1.50837 0.01446 0.00549 0.00002      0.71881 1.09105 0.01046 0.00397 0.00002
TAXI             0.76264 1.84842 0.02163 0.00212 0.00004      0.25294 0.61305 0.00717 0.00070 0.00001
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171         DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-125
                                                        ENGINE  1.PLANE 13


ENGINE TYPE AND MODEL: 0-320-B3B              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4336-39
ENGINE TOTAL TIME:     433 HRS.                        TSMOH:        HRS.
FUEL : 100 OCTANE

                            START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F        70.0    72.0               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG     29.97   29.97               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0071 # H20/# DRY AIR            TEST START : COLD
RELATIVE HUMIDITY :  44%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST     CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT             PRES  FLOW FLOW   F/A TEMP
                            IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW               800   10   10.5   101 .105  404 10.0  5.9 16435    79  10
IDLE/TAXI             1000    8   15.2   164 .093  493 10.5  7.3  5750    29   7
RUN UP                1700   14   21.1   235 .090  863  9.2  7.5  2929    89
RUN UP-L.             1600   13   18.8   210 .089  908  9.0  7.6  2766    70
RUN UP-R.             1600   13   19.9   223 .089  886  9.0  7.6  3200    69
TAKE OFF         FULL 2650   27   79.7   958 .083 1267  7.4  9.4  4068   529
CLIMB            FULL 2400   24   68.0   974 .070 1379  1.7 13.1  2658  2846  11
DESCENT          65 % 2300   23   51.6   658 .078 1267  5.7 10.6  2658   724   7
DESCENT    ON    65 % 2300   23   53.9   566 .095 1121 11.5  7.0  3743   141   4
APPROACH         40 % 1900   20   35.2   408 .086 1087  8.6  8.6  2875   208   4
TAXI                  1000    7   16.4   182 .090  482  9.2  7.4  4990    53   2

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------      --------------- #/ MIN ---------------
  MODE     HEAT
                     CO      CO2      THC      NOX      ALD          CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                                (NO2)    (HCHO)

IDLE-LOW          1.13052 1.04816 0.09045 0.00147 0.00012      0.19784 0.18343 0.01583 0.00026 0.00002
IDLE/TAXI         1.13333 1.23819 0.03021 0.00051 0.00008      0.28711 0.31367 0.00765 0.00013 0.00002
RUN UP            1.07378 1.37557 0.01664 0.00171              0.37761 0.48374 0.00585 0.00060
RUN UP-L.         1.05768 1.40352 0.01582 0.00135              0.33141 0.43977 0.00496 0.00042
RUN UP-R.         1.05496 1.39992 0.01826 0.00133              0.34990 0.46431 0.00606 0.00044
TAKE OFF          0.85296 1.70262 0.02283 0.01002              1.13301 2.26165 0.03032 0.01331
CLIMB             0.22380 2.71000 0.01703 0.06155. 0.00016     0.25364 3.07133 0.01930 0.06976 0.00018
DESCENT           0.68243 1.99427 0.01549 0.01424 0.00009      0.58689 1.71507 0.01332 0.01225 0.00008
DESCENT    ON     1.20843 1.15589 0.01915 0.00243 0.00005      1.04558 1.03838 0.01720 0.00219 0.00004
APPROACH          0.97536 1.53271 0.01587 0.00388 0.00005      0.57221 0.89919 0.00931 0.00227 0.00003
TAXI              1.06712 1.34881 0.02817 0.00101 0.00002      0.29168 0.36868 0.00770 0.00028 0.00001
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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171           DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                  RUN P-126
                                                          ENGINE  1.PLANE 13


ENGINE TYPE AND MODEL: O-320-B3B              ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4336-39
ENGINE TOTAL TIME:     433 HRS.                     TSMOH:         HRS.
FUEL : 100 OCTANE

                             START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F         75.0    77.5            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG      29.70   29.70            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0070 # H2O/# DRY AIR           TEST START : HOT
RELATIVE HUMIDITY :  36%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB   PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT             PRES  FLOW FLOW   F/A TEMP
                           IN.HG #/HR #/HR       DEG.F   %    %     PPMC   PPM PPM

IDLE-LOW              800   10   12.9   123 .105  426   9.6   5.7 16924     7  13
IDLE/TAXI            1000    8   18.8   209 .090  504   9.4   7.7  4936    42   9
RUN UP               1700   13   24.6   276 .089  874   8.8   7.4  2929    96
RUN UP-L.            1600   13   21.1   235 .090  919   8.9   7.3  2875    72
RUN UP-R.            1600   13   21.1   238 .089  874   8.5   7.5  2821    73
TAKE OFF        FULL 2650   27   68.0   828 .082 1345   7.1   9.7  3688   509
CLIMB           FULL 2400   24   56.3   752 .075 1356   4.2  11.7  2549  1115   8
DESCENT         65 % 2300   23   50.4   641 .079 1323   5.8  10.6  2549   654   8
DESCENT    ON   65 % 2300   23   51.6   535 .096 1155  11.9   6.8  3797   109   6
APPROACH        40 % 1900   20   34.0   390 .087 1121   9.0   8.4  3309   284   5
TAXI                 1000    8   17.6   198 .089  538   9.0   7.8  4665    62   6


EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ---------------
  MODE    HEAT
                  CO      CO2      THC      NOX      ALD         CO      CO2      THC      NOX      ALD
                                           (NO2)   (HCHO)                                 (NO2)   (HCHO)

IDLE-LOW        1.12050 1.04547 0.09616 0.00013 0.00016     0.24091 0.22478 0.02067 0.00003 0.00003
IDLE/TAXI       1.05967 1.36404 0.02709 0.00078 0.00011     0.33203 0.42740 0.00849 0.00024 0.00003
RUN UP          1.05823 1.39838 0.01715 0.00190             0.43398 0.57334 0.00703 0.00078
RUN UP-L.       1.07061 1.37993 0.01684 0.00142             0.37650 0.48528 0.00592 0.00050
RUN UP-R.       1.03539 1.43563 0.01673 0.00146             0.36411 0.50486 0.00588 0.00051
TAKE OFF        0.82019 1.76085 0.02074 0.00956             0.92955 1.99563 0.02350 0.01095
CLIMB           0.51563 2.25721 0.01523 0.02249 0.00011     0.48384 2.11802 0.01429 0.02110 0.00010
DESCENT         0.69069 1.98360 0.01478 0.01279 0.00010     0.58018 1.66622 0.01241 0.01075 0.00009
DESCENT   ON    1.23700 1.11078 0.01921 0.00186 0.00007     1.06382 0.95527 0.01652 0.00160 0.00006
APPROACH        1.01672 1.47652 0.01802 0.00375 0.00006     0.57647 0.83669 0.01021 0.00212 0.00003
TAXI            1.03379 1.40793 0.02608 0.00117 0.00007     0.30325 0.41299 0.00765 0.00034 0.00002
```

SCOTT RESEARCH LABORATORIES SRL 1244-014-1171 DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES RUN P-127
ENGINE 1.PLANE 13

ENGINE TYPE AND MODEL: 0-320-83B ENGINE MFGR.: LYCOMING
ENGINE SERIAL # : L-4336-39
ENGINE TOTAL TIME: 433 HRS. TSMOH: HRS.
FUEL : 100 OCTANE

	START	FINISH
INLET AIR TEMP.-DEG.F	77.5	79.0
ATMOSPHERIC PRES.-IN.HG	29.70	29.70

SAMPLE LINE :
FLOW RATE 7 LPM
TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0071 # H2O/# DRY AIR
RELATIVE HUMIDITY : 34%

TEST START : HOT

EXHAUST EMISSION CONCENTRATION DATA :

TEST MODE	CARB HEAT	PWR	RPM	MAN PRES IN.HG	FUEL FLOW #/HR	AIR FLOW #/HR	CALC F/A	EXH TEMP DEG.F	CO %	CO2 %	THC PPMC	NO PPM	ALD PPM
IDLE-LOW			800	8	15.2	165	.092	471	6.7	7.5	14410	38	9
IDLE/TAXI			1000	9	16.4	211	.078	583	5.1	10.5	3940	113	6
RUN UP			1700	13	24.6	269	.092	942	9.6	7.1	3562	131	
RUN UP-L.			1600	14	21.1	230	.092	975	9.5	7.1	3292	73	
RUN UP-R.			1600	13	22.3	250	.089	964	8.9	7.5	3400	86	
TAKE OFF		FULL	2650	27	72.7	767	.095	1199	11.3	7.1	6476	112	
CLIMB		FULL	2400	24	55.1	566	.097	1211	12.1	6.6	5181	76	7
DESCENT		65 %	2300	23	49.2	522	.094	1222	11.2	7.1	4641	110	6
DESCENT		65 %	2300	23	52.7	500	.105	1143	14.3	5.4	6476	45	6
APPROACH		40 %	1900	20	38.7	406	.095	1099	11.5	7.0	3670	86	5
TAXI			1000	8	17.6	201	.088	605	8.2	7.9	5559	57	6

EXHAUST EMISSION MASS DATA :

TEST MODE	CARB HEAT	#/# FUEL					#/ MIN				
		CO	CO2	THC	NOX (NO2)	ALD (HCHO)	CO	CO2	THC	NOX (NO2)	ALD (HCHO)
IDLE-LOW		0.04958	1.49447	0.00895	0.00079	0.00012	0.21523	0.37860	0.02253	0.00020	0.00003
IDLE/TAXI		0.63242	2.04608	0.02378	0.00230	0.00008	0.17286	0.55926	0.00650	0.00063	0.00002
RUN UP		1.11631	1.29738	0.02016	0.00193		0.45769	0.53192	0.00827	0.00079	
RUN UP-L.		1.11297	1.30711	0.01877	0.00141		0.39139	0.45967	0.00660	0.00049	
RUN UP-R.		1.05446	1.39636	0.01961	0.00167		0.39191	0.51598	0.00729	0.00062	
TAKE OFF		1.17661	1.16174	0.03282	0.00192		1.42566	1.40764	0.03977	0.00232	
CLIMB		1.24874	1.07035	0.02603	0.00129	0.00008	1.14676	0.98293	0.02390	0.00118	0.00007
DESCENT		1.18382	1.17929	0.02398	0.00191	0.00007	0.97073	0.96702	0.01958	0.00157	0.00006
DESCENT		1.39386	0.82712	0.03073	0.00072	0.00006	1.22427	0.72649	0.02699	0.00063	0.00006
APPROACH		1.20890	1.15634	0.01878	0.00149	0.00006	0.77974	0.74584	0.01211	0.00096	0.00004
TAXI		0.97643	1.47825	0.03222	0.00112	0.00008	0.28642	0.43362	0.00945	0.00033	0.00002

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SCOTT RESEARCH LABORATORIES      SRL 1244-014-1171            DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                 RUN P-120
                                                           ENGINE  3.PLANE  2


ENGINE TYPE AND MODEL: O-470-R                  ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 133510-6-R
ENGINE TOTAL TIME:      69 HRS.                       TSMOH:      69 HRS.
FUEL : 80 OCTANE

                              START  FINISH          SAMPLE LINE :
INLET AIR TEMP.-DEG.F          75.0    74.5            FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG       30.12   30.12            TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0085 # H20/# DRY AIR            TEST START : COLD
RELATIVE HUMIDITY :  47%

EXHAUST EMISSION CONCENTRATION DATA :

  TEST     CARB   PWR RPM  MAN   FUEL AIR  CALC EXH    CO   CO2    THC    NO  ALD
  MODE     HEAT            PRES  FLOW FLOW  F/A TEMP
                           IN.HG #/HR #/HR      DEG.F  *    %     PPMC   PPM PPM

IDLE-LOW             700   18   14.1    90 .156  620  8.4  3.9 72414     3  36
IDLE/TAXI           1000   17   16.7   169 .099  930 10.3  7.2 14971     8  27
RUN UP              1700   18   30.9   388 .080 1256  6.0  9.9  1682   167
RUN UP-L.           1600   19   30.0   403 .075 1390  4.1 11.4   868   100
RUN UP-R.           1600   19   30.0   397 .076 1356  4.5 11.2  1139    95
TAKE OFF       FULL 2500   27   97.7  1131 .086 1536  9.0  9.0  2278    38
CLIMB          75 % 2450   23   71.3   937 .076 1558  4.9 11.5  1193   114   8
DESCENT        65 % 2200   22   62.3   802 .078 1513  5.5 10.9  1248    89   8
DESCENT        65 * 2200   22   66.3   696 .095 1323 11.7  7.1  2332    17   6
APPROACH       40 * 1800   22   42.0   517 .081 1323  6.8  9.8  1356   266   7
TAXI                1000   17   15.8   156 .101  964 10.9  7.0 15296     6  13

EXHAUST EMISSION MASS DATA :

  TEST     CARB   --------------- #/# FUEL ---------------     ---------------- #/ MIN ----------------
  MODE     HEAT
                    CO      CO2      THC      NOX      ALD        CO      CO2      THC      NOX      ALD
                                              (NO2)    (HCHO)                               (NO2)    (HCHO)

IDLE-LOW          0.85255 0.62201 0.35777 0.00005 0.00039     0.20035 0.14617 0.08408 0.00001 0.00009
IDLE/TAXI         1.07534 1.18123 0.07608 0.00014 0.00030     0.29930 0.32878 0.02118 0.00004 0.00008
RUN UP            0.74059 1.92025 0.01011 0.00339             0.38141 0.98893 0.00520 0.00174
RUN UP-L.         0.52170 2.27949 0.00538 0.00209             0.26985 1.13975 0.00269 0.00105
RUN UP-R.         0.56438 2.20734 0.00695 0.00196             0.28219 1.10367 0.00348 0.00098
TAKE OFF          0.97927 1.53886 0.01207 0.00068             1.59458 2.50577 0.01965 0.00111
CLIMB             0.58830 2.16968 0.00697 0.00225 0.00010     0.69910 2.57831 0.00829 0.00267 0.00012
DESCENT           0.66012 2.05580 0.00729 0.00175 0.00010     0.68542 2.13460 0.00757 0.00182 0.00011
DESCENT           1.21919 1.16262 0.01183 0.00029 0.00007     1.34720 1.28469 0.01307 0.00032 0.00007
APPROACH          0.80587 1.82505 0.00782 0.00518 0.00009     0.56411 1.27754 0.00548 0.00363 0.00006
TAXI              1.11265 1.12286 0.07601 0.00010 0.00014     0.29300 0.29569 0.02001 0.00003 0.00004
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SCOTT RESEARCH LABORATORIES     SRL 1244-014-1171          DATE 10/11/71
AIRCRAFT EMISSIONS BASELINE DATA - PISTON ENGINES                RUN P-129
                                                          ENGINE  3.PLANE  2


ENGINE TYPE AND MODEL: 0-470-R                    ENGINE MFGR.: CONTINENTAL
ENGINE SERIAL # : 133510-6-R
ENGINE TOTAL TIME:      69 HRS.                         TSMOH:      69 HRS.
FUEL : 80 OCTANE

                           START  FINISH             SAMPLE LINE :
INLET AIR TEMP.-DEG.F       83.5    83.5               FLOW RATE    7 LPM
ATMOSPHERIC PRES.-IN.HG    30.12   30.12               TRANS. TIME 1.6 SEC.

INLET AIR HUMIDITY: .0091 # H20/# DRY AIR            TEST START : HOT
RELATIVE HUMIDITY :  38%

EXHAUST EMISSION CONCENTRATION DATA :


  TEST    CARB  PWR RPM   MAN   FUEL AIR   CALC EXH    CO   CO2    THC    NO  ALD
  MODE    HEAT            PRES  FLOW FLOW   F/A TEMP
                          IN.HG #/HR #/HR       DEG.F   %     %    PPMC   PPM PPM

IDLE-LOW              700   18   12.4   77 .161  538  7.6   3.7 74911     3  36
IDLE/TAXI            1000   17   15.8  164 .097  897  9.9   7.5 12566    10  24
RUN UP               1700   18   30.9  383 .081 1256  6.2   9.7  5155   134
RUN UP-L.            1600   19   30.0  402 .075 1390  3.9  11.3  2255    80
RUN UP-R.            1600   19   30.9  409 .076 1345  4.3  10.9  3222    73
TAKE OFF        FULL 2500   27   77.5 1140 .068 1681  0.7  14.0  1772  3281
CLIMB           75 % 2450   23   73.4 1093 .067 1704  0.5  13.9  1289  4205  12
DESCENT         65 % 2200   22   41.1  565 .073 1592  3.6  13.5  1933  2681  12

EXHAUST EMISSION MASS DATA :

  TEST    CARB  --------------- #/# FUEL ---------------    ---------------- #/ MIN ----------------
  MODE    HEAT
                    CO      CO2       THC       NOX       ALD          CO      CO2       THC       NOX       ALD
                                                (NO2)    (HCHO)                                    (NO2)    (HCHO)

IDLE-LOW          0.80215 0.61368 0.38498 0.00005 0.00041     0.16578 0.12683 0.07954 0.00001 0.00008
IDLE/TAXI         1.05244 1.25291 0.06503 0.00017 0.00027     0.27714 0.32993 0.01712 0.00005 0.00007
RUN UP            0.74909 1.84165 0.03032 0.00266             0.38578 0.94845 0.01561 0.00137
RUN UP-L.         0.50144 2.28312 0.01411 0.00169             0.25872 1.14156 0.00706 0.00084
RUN UP-R.         0.54943 2.18859 0.02004 0.00153             0.28296 1.12712 0.01032 0.00079
TAKE OFF          0.09332 2.93290 0.01150 0.07186             0.12054 3.78833 0.01485 0.09282
CLIMB             0.06873 2.98082 0.00862 0.09498 0.00018     0.08408 3.64654 0.01855 0.11619 0.00022
DESCENT           0.41288 2.43302 0.01079 0.05051 0.00015     0.28282 1.66662 0.00739 0.03460 0.00010
```

APPENDIX II

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

RUN NO. P113

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 72.0

Barometric Pressure: 30.28

Engine Type: LYC-0-540-A1B5

Engine: 9 , Plane: 2

						Mass Emissions			
Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		800	12.0	.382	3.2	.00046	.00219	.00193	M
Climb		2400	23.5	1.847	8.5	.00493	.01259	.00994	M
Descent		2300	24.0	1.143	7.8	.00339	.01067	.00876	M
Descent	On	2300	23.0	1.172	8.3	.00301	.00757	.00980	M
Approach		1900	18.0	1.113	6.8	.00370	.01008	.00614	M
Taxi		1000	12.0	.410	3.75	.00082	.00192	.00198	M

RUN NO. P114

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 77.0

Barometric Pressure: 30.28

Engine Type: LYC 0-540-A1B5

Engine: 9 , Plane: 2

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		800	12.0	.382	3.15	.00068	.00232	.00133	3.53×10^{-7}
Climb		2400	24.0	1.290	8.30	.00360	.00942	.00750	2.45×10^{-5}
Descent		2300	23.0	1.143	8.30	.00390	.01224	.00803	3.28×10^{-5}
Descent	On	2300	23.0	1.318	7.95	.00603	.00857	.00810	9.48×10^{-6}
Approach		1900	19.0	.850	6.65	.00384	.00339	.00609	1.65×10^{-6}
Taxi		1000	12.0	.410	3.60	.00078	.00245	.00156	4.18×10^{-7}

RUN NO. P115

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 85.5

Barometric Pressure: 30.29

Engine Type: LYC 0-540-A1B5

Engine: 9, Plane: 2

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	Mass Emissions CO_2 #/min.	Mass Emissions THC #/min.	Mass Emissions NO #/min.
Idle-Low		800	12.0	.382	3.3	.00047	.00241	.00162	4.99×10^{-7}
Climb		2400	28.5	1.318	8.5	.00487	.01244	.00929	3.09×10^{-5}
Descent		2300	23.0	1.260	8.5	.00487	.01292	.00909	3.15×10^{-5}
Descent	On	2300	23.0	1.407	8.1	.00638	.00821	.00867	1.23×10^{-5}
Approach		1900	17.0	.967	7.3	.00314	.00575	.00665	5.53×10^{-6}
Taxi		1000	12.0	.498	4.05	.00073	.00296	.00189	6.74×10^{-6}

RUN NO. P116

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 89.75

Barometric Pressure: 30.06

Engine Type: CONT IO-470-VO

Engine: 5 , Plane: 3

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		700	18.0	.322	4.45	.00063	.00124	.00150	1.33×10^{-7}
Climb		2450	24.0						
Descent		2300	22.0						
Descent	On								
Approach		2100	20.0						
Taxi		1000	16.0	.410	6.80	.00073	.00114	.00168	0

RUN NO. P118

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 82.25

Barometric Pressure: 30.04

Engine Type: CONT IO-470-VO

Engine: 5 , Plane: 3

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	Mass Emissions CO_2 #/min.	Mass Emissions THC #/min.	Mass Emissions NO #/min.
Idle-Low		700	17.0	.352	4.90	.00035	.00110	.00149	5.49×10^{-8}
Climb		2450	24.0	1.320	10.88	.00078	.00245	.00137	9.74×10^{-7}
Descent		2300	22.0	1.170	10.79	.00077	.00243	.00149	1.37×10^{-6}
Descent	On								
Approach		2100	21.0	.996	10.67	.00076	.00240	.00190	4.77×10^{-7}
Taxi		1000	16.0	.410	6.49	.00046	.00146	.00160	4.83×10^{-8}

RUN NO. P119

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 86.0

Barometric Pressure: 30.04

Engine Type: CONT IO-470-VO

Engine: 5 , Plane: 4

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		700	18.0	.176	3.41	.00073	.00153	.00181	2.24×10^{-7}
Climb		2450	24.0	1.289	10.64	.00076	.00119	.00209	1.05×10^{-6}
Descent		2300	22.0	1.055	10.49	.00075	.00118	.00218	3.83×10^{-7}
Descent	On								
Approach		2100	21.0	.850	10.42	.00074	.00117	.00217	3.04×10^{-7}
Taxi		1000	16.0	.234	8.84	.00126	.00198	.00327	0

RUN NO. P120

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 90.0

Barometric Pressure: 30.05

Engine Type: CONT IO-470-VO

Engine: 5, Plane: 4

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions			
						CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		700	18.0	.527	3.20	.00057	.00143	.00180	1.66×10^{-7}
Climb		2450	24.0	.703	10.57	.00075	.00118	.00230	7.85×10^{-7}
Descent		2300	22.0	.645	10.35	.00074	.00116	.00213	6.15×10^{-7}
Descent	On								
Approach		2100	21.0	.615	10.25	.00073	.00114	.00221	4.57×10^{-7}
Taxi		1000	16.0	.469	4.82	.00069	.00135	.00182	1.61×10^{-7}

RUN NO. P121

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 77.75

Barometric Pressure: 30.04

Engine Type: CONT-IO-470-VO

Engine: 5, Plane: 4

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions			
						CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		700	18.0	.527	2.79	.00040	.00126	.00135	1.56×10^{-7}
Climb		2450	24.0	.703	10.53	.00114	.00238	.00231	2.04×10^{-6}
Descent		2300	22.0	.645	10.32	.00111	.00175	.00220	7.32×10^{-7}
Descent	On								
Approach		2100	21.0	.615	10.18	.00073	.00172	.00211	4.94×10^{-7}
Taxi		1000	15.5	.454	4.75	.00051	.00134	.00162	1.77×10^{-7}

RUN NO. P122

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 80.50

Barometric Pressure: 29.80

Engine Type: LYC 0-320-B3B

Engine: 1, Plane: 12

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	Mass Emissions CO_2 #/min.	Mass Emissions THC #/min.	Mass Emissions NO #/min.
Idle-Low		800	10.0	.254	2.39	.00026	.00067	.00088	M
Climb		2400	24.0	.742	7.16	.00051	.00080	.00397	M
Descent		2300	23.0	.723	6.94	.00099	.00234	.00435	M
Descent	On	2300	23.0	.723	6.79	.00097	.00152	.00439	M
Approach		1900	20.0	.586	5.70	.00081	.00096	.00351	M
Taxi		1000	9.75	.332	2.69	.00029	.00060	.00104	M

RUN NO. P123

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 74.25

Barometric Pressure: 29.80

Engine Type: LYC 0-320-B3B

Engine: 1 , Plane: 12

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions			
						CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		800	10.0	.254	1.77	.00013	.00040	.00049	M
Climb		2400	24.0	1.035	7.29	.00105	.00247	.00391	M
Descent		2300	23.0	.937	6.75	.00097	.00228	.00393	M
Descent	On	2300	23.0	.996	6.75	.00121	.00190	.00393	M
Approach		1900	20.0	.742	6.15	.00132	.00208	.00421	M
Taxi		1000	9.5	.313	2.76	.00020	.00078	.00086	M

RUN NO. P124

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 67.0

Barometric Pressure: 29.97

Engine Type: LYC 0-320-B3B

Engine: 1 , Plane: 12

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		800	9.0	.254	2.27	.00016	.00065	.00067	8.65×10^{-8}
Climb		2400	24.0	1.04	5.36	.00117	.00305	.00393	3.83×10^{-6}
Descent		2300	23.0	.918	4.98	.00108	.00284	.00391	2.63×10^{-6}
Descent	On	2300	23.0	.977	5.01	.00145	.00228	.00425	3.62×10^{-7}
Approach		1900	20.0	.742	4.91	.00142	.00224	.00434	6.45×10^{-7}
Taxi		1000	9.0	.313	2.72	.00030	.00093	.00096	1.37×10^{-7}

RUN NO. P125

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 71.0
Barometric Pressure: 29.97

Engine Type: LYC-0-320-B3B
Engine: 1 , Plane: 13

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO$_2$ #/min.	THC #/min.	NO #/min.
Idle-Low		800	8.0	.215	3.09	.00045	.00070	.00087	5.98×10^{-8}
Climb		2400	24.0	.879	7.92	.00172	.00360	.00127	4.50×10^{-6}
Descent		2300	23.0	.781	7.43	.00161	.00295	.00383	3.49×10^{-6}
Descent	On	2300	23.0	.840	7.43	.00215	.00253	.00417	8.23×10^{-7}
Approach		1900	20.0	.547	6.67	.00193	.00189	.00379	3.93×10^{-7}
Taxi		1000	7.0	.273	3.74	.00054	.00085	.00115	8.98×10^{-8}

RUN NO. P126

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 76.25

Barometric Pressure: 29.70

Engine Type: LYC-0-320-B3B

Engine: 1, Plane: 13

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	Mass Emissions CO_2 #/min.	Mass Emissions THC #/min.	Mass Emissions NO #/min.
Idle-Low		800	8.0	.254	3.24	.00070	.00058	.00105	8.45×10^{-8}
Climb		2400	24.0	.859	8.15	.00204	.00233	.00416	4.79×10^{-6}
Descent		2300	23.0	.762	7.58	.00217	.00190	.00426	2.90×10^{-6}
Descent	On	2300	23.0	.820	7.43	.00239	.00159	.00426	6.10×10^{-7}
Approach		1900	20.0	.566	6.52	.00163	.00117	.00367	5.10×10^{-7}
Taxi		1000	8.0	.293	3.74	.00054	.00054	.00112	1.12×10^{-7}

RUN NO. P127

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 78.25

Barometric Pressure: 29.70

Engine Type: LYC-O-320-B3B

Engine: 1, Plane: 13

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		800	8.0	.254	3.06	.00055	.00055	.00090	4.45×10^{-8}
Climb		2400	24.0	.918	7.77	.00139	.00194	.00376	3.43×10^{-6}
Descent		2300	23.0	.840	7.58	.00162	.00217	.00406	2.77×10^{-6}
Descent	On	2300	23.0	.879	7.43	.00159	.00133	.00411	4.89×10^{-7}
Approach		1900	20.0	.645	6.49	.00139	.00116	.00351	5.22×10^{-7}
Taxi		1000	8.0	.293	3.59	.00051	.00051	.00099	6.60×10^{-8}

RUN NO. P128

CRANKCASE VENTILATION - AIRCRAFT PISTON ENGINES

Temperature: 74.75

Barometric Pressure: 30.12

Engine Type: CONT-0-470-R

Engine: 3, Plane: 2

Mode	Carb. Heat	RPM	Man. Press. In. Hg.	Fuel Flow #/min.	Crankcase Vent Flow SCFM	Mass Emissions CO #/min.	CO_2 #/min.	THC #/min.	NO #/min.
Idle-Low		700	19.0	.176	.150	.00005	.00005	.00006	5.57×10^{-9}
Climb		2450	23.0	1.296	.941	.00109	.00293	.00303	6.11×10^{-6}
Descent		2200	22.0	1.018	.891	.00103	.00283	.00307	1.52×10^{-6}
Descent	On	2200	24.0	1.185	.927	.00217	.00231	.00352	1.15×10^{-6}
Approach		1800	22.0	.722	.891	.00135	.00293	.00328	3.65×10^{-6}
Taxi		1000	17.0	.259	.150	.00005	.00005	.00006	3.36×10^{-9}

APPENDIX III

AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES

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SCOTT RESEARCH LABORATORIES                                SRL 1244-014-1171                                   DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                                   RUN T-001
                                                                                                         ENGINE  1.NUMBER  1

ENGINE TYPE AND MODEL: TF 30-P6C
ENGINE SERIAL # : 651983
ENGINE TOTAL TIME: 1159.0 HRS.           TSMOH :         HRS.            TIME SINCE :
FUEL : JP-5                                                                N1 COMPRESSOR OH :                  HRS.
                                                                           N2 COMPRESSOR OH :                  HRS.
                              START  FINISH         SAMPLE LINE :          COMBUSTOR CAN RPLC:                 HRS.
INLET AIR TEMP.-DEG.F          86.0    87.0          MIN FLOW RATE: 16 LPM  NOZZLE GUIDE VANE OH:               HRS.
ATMOSPHERIC PRES.-IN.HG       30.02   29.99          MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :                   HRS.
                                                     TEMP.:  237 DEG.F       N2 TURBINE OH :                   HRS.
INLET AIR HUMIDITY: .0177 # H2O/# DRY AIR
RELATIVE HUMIDITY :  65%
                                                     PROBE USED : EPA J-57 MOD II


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST     THRUST   PWR     N1     N2    FUEL      AIR CALC EXH     EXH    EPR    CO   CO2     THC     NO    NO2  C-NO    ALD
  MODE                     RPM    RPM    FLOW     FLOW  F/A TEMP   PRESS         DRY   DRY     WET    DRY    WET   DRY    WET
             #                           #/HR     #/HR      DEG.F  IN.HG         PPM    %     PPMC    PPM    PPM   PPM    PPM

75% POWER  5660   75 %  7630 12856   3135 463740 .007 1349    14.0 1.477   36  1.40           10.0   4.0          1.0
NORMAL     7443   92 %  8370 13390   4130 390845 .011 1499    19.0 1.647   27  2.20           35.0   2.5          3.0
NORMAL     7443   92 %  8370 13398   4130 421290 .010 1499    19.0 1.647   19  2.04           35.0   2.5          2.0
MILITARY  11457  100 %  9811 14557   6885 410180 .017 1865    31.0 2.057   18  3.52          120.0   5.0          1.0
MILITARY  11430  100 %  9811 14580   6865 411225 .017 2005    31.0 2.057   23  3.50          120.0   6.0

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
              CO      CO2      THC       NOX      ALD           CO       CO2       THC        NOX      ALD
                                        (NO2)    (HCHO)                                     (NO2)    (HCHO)

75% POWER  0.00527   3.17              .00337  0.00016       0.27546   165.73              .17585  0.00843
NORMAL     0.00251   3.18              .00569  0.00031       0.17307   218.63              .39151  0.02140
NORMAL     0.00188   3.18              .00615  0.00022       0.12913   218.69              .42309  0.01537
MILITARY   0.00104   3.18              .01182  0.00007       0.11921   364.73             1.35705  0.00751
MILITARY   0.00135   3.18              .01200                0.15473   363.61             1.37268
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SCOTT RESEARCH LABORATORIES                                  SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                              DATE 10/27/71
                                                                                                                  RUN T-002
                                                                                                          ENGINE  3.NUMBER  1

ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : P630439
ENGINE TOTAL TIME: 3664.5 HRS.
FUEL : JP-5                                        TSMOH :         HRS.             TIME SINCE :
                                                                                       N1 COMPRESSOR OH :               HRS.
                                 START  FINISH                                         N2 COMPRESSOR OH :               HRS.
INLET AIR TEMP.-DEG.F             78.5    78.5              SAMPLE LINE :              COMBUSTOR CAN RPLC:              HRS.
ATMOSPHERIC PRES.-IN.HG          29.94   29.96                MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:            HRS.
                                                              MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :                  HRS.
INLET AIR HUMIDITY: .0153 # H2O/# DRY AIR                     TEMP.:  210 DEG.F        N2 TURBINE OH :                  HRS.
RELATIVE HUMIDITY :  73%
                                                              PROBE USED : J-57


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST   THRUST  PWR     N1     N2    FUEL     AIR CALC EXH     EXH    EPR    CO    CO2     THC     NO     NO2   C-NO    ALD
  MODE                  RPM    RPM    FLOW    FLOW  F/A TEMP   PRESS          DRY   DRY     WET    DRY    WET    DRY    WET
           #                          #/HR    #/HR      DEG.F  IN.HG          PPM    %      PPMC   PPM    PPM    PPM    PPM
IDLE                                                .009
75% POWER  6230  75 %   5430   8845   5100 490362  .010  870    25.0 1.835   577  1.65  1090.0
NORMAL     8310  92 %   5770   9150   6680 613395  .011  995    34.7 2.170    35  2.16    40.0                             2.0
                                                                              27  2.26    79.0                             3.0

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
            CO       CO2     THC        NOX      ALD           CO       CO2      THC         NOX      ALD
                                       (NO2)    (HCHO)                                      (NO2)    (HCHO)
IDLE      0.06427   2.88  0.06156
75% POWER 0.00323   3.17  0.00191              0.00021      0.27459  269.35  0.16202                0.01783
NORMAL    0.00242   3.16  0.00359              0.00030      0.26989  352.34  0.39919                0.03337
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SCOTT RESEARCH LABORATORIES                      SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                             DATE 10/27/71
                                                                                                  RUN T-003
                                                                                          ENGINE  3.NUMBER  2


ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : P631861
ENGINE TOTAL TIME: 3509.1 HRS.           TSMOH :        HRS.           TIME SINCE :
FUEL : JP-5                                                               N1 COMPRESSOR OH :              HRS.
                                                                          N2 COMPRESSOR OH :              HRS.
                               START  FINISH         SAMPLE LINE :        COMBUSTOR CAN RPLC:             HRS.
INLET AIR TEMP.-DEG.F           78.0    78.0          MIN FLOW RATE: 16 LPM   NOZZLE GUIDE VANE OH:       HRS.
ATMOSPHERIC PRES.-IN.HG        29.94   29.95          MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :            HRS.
                                                      TEMP.:  210 DEG.F        N2 TURBINE OH :            HRS.
INLET AIR HUMIDITY: .0187 # H2O/# DRY AIR
RELATIVE HUMIDITY :  98%
                                                     PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST   THRUST  PWR     N1     N2   FUEL    AIR CALC EXH    EXH   EPR    CO   CO2     THC    NO    NO2  C-NO   ALD
  MODE                  RPM    RPM   FLOW   FLOW  F/A TEMP  PRESS         DRY  DRY     WET   DRY    WET   DRY   WET
           #                         #/HR   #/HR      DEG.F IN.HG         PPM   %     PPMC   PPM    PPM   PPM   PPM

IDLE       420         2140   5897   1100 158232 .007  573                665  1.24 1340.0  10.0    5.0   5.0   2.0
75% POWER 6334   75 %  5420   8893   5187 548661 .009  890   25.0 1.842    50  1.96   33.0  20.0   12.5  25.6   1.0
NORMAL    7916   92 %  5780   9147   6390 590616 .011  980   32.0 2.079    30  2.25   28.0  33.0   10.0  33.5   0.3
MILITARY  9675  100 %  6020   9405   7770 635003 .012 1080   39.9 2.346    24  2.55   26.2  52.0   10.0  59.0   0.1

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
               CO    CO2     THC        NOX     ALD             CO      CO2      THC       NOX     ALD
                                       (NO2)   (HCHO)                                     (NO2)   (HCHO)

IDLE       0.09289  2.73  0.09512    .00350  0.00031        1.70307   50.00  1.74396    .06413  0.00573
75% POWER  0.00517  3.17  0.00173    .00557  0.00012        0.44713  273.73  0.14964    .48206  0.00998
NORMAL     0.00264  3.17  0.00129    .00640  0.00003        0.28126  337.80  0.13691    .68155  0.00323
MILITARY   0.00193  3.17  0.00107    .00815  0.00001        0.24960  410.99  0.13841   1.05544  0.00116
```

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SCOTT RESEARCH LABORATORIES                            SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                         DATE 10/27/71
                                                                                                              RUN T-004
                                                                                                     ENGINE  3.NUMBER  3


ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : 626995
ENGINE TOTAL TIME: 5141.3 HRS.               TSMOH :        HRS.           TIME SINCE :
FUEL : JP-5                                                                   N1 COMPRESSOR OH :             HRS.
                                                                              N2 COMPRESSOR OH :             HRS.
                               START  FINISH           SAMPLE LINE :          COMBUSTOR CAN RPLC:            HRS.
INLET AIR TEMP.-DEG.F           83.0    83.0            MIN FLOW RATE: 16 LPM NOZZLE GUIDE VANE OH:          HRS.
ATMOSPHERIC PRES.-IN.HG        30.10   30.10            MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :              HRS.
                                                        TEMP.:  230 DEG.F     N2 TURBINE OH :                HRS.
INLET AIR HUMIDITY: .0167 # H2O/# DRY AIR
RELATIVE HUMIDITY :  69%
                                                        PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST   PWR     N1     N2    FUEL      AIR CALC EXH     EXH    EPR     CO    CO2      THC     NO    NO2  C-NO    ALD
  MODE                    RPM    RPM    FLOW     FLOW  F/A TEMP   PRESS          DRY    DRY      WET    DRY    WET   DRY    WET
             #                          #/HR     #/HR      DEG.F  IN.HG          PPM     %      PPMC    PPM    PPM   PPM    PPM

IDLE         500          2130   5920   1040 150672 .007                          605   1.25 1200.0   10.0    7.5          15.0
75% POWER   6460   75 %   5530   8920   5220 560742 .009   900          1.838      41   1.93   37.5   22.0   11.0           0.3
NORMAL      8300   92 %                                .011                        33   2.28   30.0   45.0   10.0           0.3

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
             CO       CO2      THC        NOX      ALD            CO        CO2      THC        NOX      ALD
                                         (NO2)    (HCHO)                                       (NO2)    (HCHO)

IDLE       0.00546   2.77   0.00577    .00413   0.00236        1.48129    47.99   1.48674    .07150   0.04090
75% POWER  0.00427   3.17   0.00200    .00576   0.00004        0.37163   275.52   0.17395    .50095   0.00306
NORMAL     0.00288   3.17   0.00136    .00808   0.00003
```

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SCOTT RESEARCH LABORATORIES                      SRL 1244-014-1171                               DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                   RUN T-005
                                                                                           ENGINE  1.NUMBER  2


ENGINE TYPE AND MODEL: TF 30-P408
ENGINE SERIAL # : P664211
ENGINE TOTAL TIME:  725.7 HRS.            TSMOH :        HRS.             TIME SINCE :
FUEL : JP-5                                                                  N1 COMPRESSOR OH :          HRS.
                                                                             N2 COMPRESSOR OH :          HRS.
                          START  FINISH          SAMPLE LINE :               COMBUSTOR CAN RPLC:         HRS.
INLET AIR TEMP.-DEG.F      75.0    75.0           MIN FLOW RATE: 16 LPM      NOZZLE GUIDE VANE OH:       HRS.
ATMOSPHERIC PRES.-IN.HG   30.07   30.07           MAX TRANS TIME: 2.4 SEC    N1 TURBINE OH :             HRS.
                                                  TEMP.:  230 DEG.F          N2 TURBINE OH :             HRS.
INLET AIR HUMIDITY: .0178 # H2O/# DRY AIR
RELATIVE HUMIDITY :  95%
                                                  PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST   THRUST  PWR     N1   N2    FUEL    AIR CALC EXH    EXH   EPR   CO   CO2    THC    NO    NO2 C-NO   ALD
  MODE                 RPM  RPM    FLOW    FLOW F/A TEMP  PRESS        DRY  DRY    WET   DRY    WET  DRY   WET
            #                      #/HR    #/HR     DEG.F IN.HG        PPM   %     PPMC  PPM    PPM  PPM   PPM

IDLE        820        3305  8746   740  85349 .009  950               640  1.70  382.0   5.0   4.7          2.0
MILITARY  12240 100 %              7570 441024 .017 2005        2.378   28  3.60        160.0                 1.0

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------       ---------------- #/ MIN -----------------
  MODE
                CO    CO2   THC         NOX     ALD            CO     CO2     THC       NOX     ALD
                                       (NO2)   (HCHO)                                  (NO2)   (HCHO)

IDLE         0.07203  3.00  0.02189   .00184  0.00025       0.08839   36.95  0.26993   .02266  0.00311
MILITARY     0.00156  3.18            .01476  0.00006       0.19625 400.92            1.86256  0.00809
```

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SCOTT RESEARCH LABORATORIES                             SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                        DATE 10/27/71
                                                                                                             RUN T-006
                                                                                                     ENGINE  2.NUMBER  1

ENGINE TYPE AND MODEL: J 52-P8A
ENGINE SERIAL # : 677106
ENGINE TOTAL TIME:    474 HRS.              TSMOH :    474 HRS.          TIME SINCE :
FUEL : JP-5                                                                 N1 COMPRESSOR OH :         4740 HRS.
                                                                            N2 COMPRESSOR OH :         4740 HRS.
                          START  FINISH              SAMPLE LINE :          COMBUSTOR CAN RPLC:             HRS.
INLET AIR TEMP.-DEG.F      83.5    84.0               MIN FLOW RATE: 16 LPM NOZZLE GUIDE VANE OH:      4740 HRS.
ATMOSPHERIC PRES.-IN.HG   30.10   30.10               MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :          4740 HRS.
                                                      TEMP.:  100 DEG.F     N2 TURBINE OH :            4740 HRS.
INLET AIR HUMIDITY: .0149 # H2O/# DRY AIR
RELATIVE HUMIDITY :  60%
                                                      PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2   FUEL      AIR CALC EXH    EXH    EPR    CO   CO2    THC    NO    NO2  C-NO   ALD
  MODE                   RPM    RPM   FLOW     FLOW  F/A TEMP  PRESS          DRY  DRY    WET   DRY   WET   DRY   WET
            #                         #/HR     #/HR      DEG.F IN.HG          PPM   %     PPMC  PPM   PPM   PPM   PPM
IDLE        483                 6898   700 115934 .006  500
75% POWER  5600   75 %         10974  4220 382003 .011  880                   410  1.10  309.0   5.0   5.0   6.0   9.0
NORMAL     7570   92 %         11569  5850 457425 .013 1040          2.045    24  2.30   15.0  50.0   8.0         1.0
MILITARY   8230  100 %         11774  6490 459902 .014 1100    42.6 2.412    19  2.67    2.0  80.0   7.5  80.0   3.0
                                                               46.7 2.547    24  2.95    1.4  90.0   6.0  92.0   2.0

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------       ----------------- #/ MIN -----------------
  MODE
              CO      CO2    THC       NOX      ALD          CO       CO2      THC        NOX      ALD
                                      (NO2)    (HCHO)                                    (NO2)    (HCHO)
IDLE        0.06620  2.99  0.02515   .00269  0.00161
75% POWER   0.00211  3.17  0.00067   .00842  0.00010      0.77237    34.94  0.29338    .03140  0.01881
NORMAL      0.00143  3.18  0.00008   .01093  0.00026      0.14855   223.28  0.04716    .59206  0.00692
MILITARY    0.00166  3.18  0.00005   .01084  0.00015      0.13972   309.82  0.00756   1.06606  0.02495
                                                          0.17965   343.68  0.00532   1.17287  0.01674
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SCOTT RESEARCH LABORATORIES                              SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                        DATE 10/27/71
                                                                                                            RUN T-007
                                                                                               ENGINE  1.NUMBER  3

ENGINE TYPE AND MODEL: TF 30-P6C
ENGINE SERIAL # : 652017
ENGINE TOTAL TIME: 1101.0 HRS.              TSMOH :  851.3 HRS.              TIME SINCE :
FUEL :                                                                          N1 COMPRESSOR OH :        4597 HRS.
                               START  FINISH                                   N2 COMPRESSOR OH :        8513 HRS.
INLET AIR TEMP.-DEG.F           76.0    76.0          SAMPLE LINE :            COMBUSTOR CAN RPLC:            HRS.
ATMOSPHERIC PRES.-IN.HG        30.04   30.04           MIN FLOW RATE: 16 LPM   NOZZLE GUIDE VANE OH:          HRS.
                                                       MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :          5253 HRS.
INLET AIR HUMIDITY: .0167 # H20/# DRY AIR              TEMP.:  250 DEG.F       N2 TURBINE OH :          7772 HRS.
RELATIVE HUMIDITY :  87%

                                                      PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST   THRUST  PWR    N1    N2    FUEL      AIR CALC EXH    EXH    EPR     CO   CO2     THC     NO    NO2  C-NO    ALD
  MODE                 RPM   RPM    FLOW     FLOW  F/A TEMP  PRESS           DRY  DRY     WET    DRY    WET   DRY    WET
            #                       #/HR     #/HR      DEG.F IN.HG           PPM   %      PPMC   PPM    PPM   PPM    PPM
IDLE                                                .009                     815  1.84
75% POWER  5961   75 %  7725 12840  3410 293807 .012 1483   15.5 1.527    20  2.42                   3.0
NORMAL     7905   92 %  8500 13453  4550 362581 .013 1650   21.4 1.729    13  2.62                   4.0
MILITARY  11160  100 %  9697 14417  6915 501997 .014 1990   31.4 2.069    11  2.88                   8.0
                                                                                                     4.0

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
              CO     CO2     THC       NOX      ALD             CO        CO2      THC        NOX      ALD
                                      (NO2)    (HCHO)                                         (NO2)    (HCHO)
IDLE
75% POWER   0.00167  3.18                                     0.09493   180.59
NORMAL      0.00097  3.18                                     0.07392   241.04
MILITARY    0.00074  3.18                                     0.08540   366.37
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SCOTT RESEARCH LABORATORIES                         SRL 1244-014-1171                                DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                     RUN T-008
                                                                                              ENGINE  2.NUMBER  2


ENGINE TYPE AND MODEL: J 52-P8A
ENGINE SERIAL # : 677316                                                   TIME SINCE :
ENGINE TOTAL TIME:  309.6 HRS.          TSMOH :  309.6 HRS.                  N1 COMPRESSOR OH :          3096 HRS.
FUEL : JP-5                                                                  N2 COMPRESSOR OH :          3096 HRS.
                                                                             COMBUSTOR CAN RPLC:              HRS.
                          START  FINISH          SAMPLE LINE :               NOZZLE GUIDE VANE OH:       3096 HRS.
INLET AIR TEMP.-DEG.F      86.0    85.5           MIN FLOW RATE: 16 LPM      N1 TURBINE OH :             3096 HRS.
ATMOSPHERIC PRES.-IN.HG    30.14   30.14          MAX TRANS TIME: 2.4 SEC    N2 TURBINE OH :             3096 HRS.
                                                  TEMP.:  215 DEG.F
INLET AIR HUMIDITY: .0113 # H2O/# DRY AIR
RELATIVE HUMIDITY :  43%                         PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

 TEST    THRUST  PWR     N1     N2    FUEL     AIR  CALC EXH     EXH    EPR    CO   CO2    THC     NO    NO2   C-NO   ALD
 MODE                   RPM    RPM    FLOW    FLOW   F/A TEMP   PRESS         DRY   DRY    WET    DRY    WET    DRY   WET
           #                          #/HR    #/HR      DEG.F   IN.HG         PPM    %    PPMC    PPM    PPM    PPM   PPM

IDLE        470                6870    685  129448 .005  500                   340  1.04  225.0    5.0    7.0    2.5   7.4
IDLE        480                6910    700  159858 .004  500                   340  0.85  225.0    5.0    8.0    2.5
IDLE                                               .005                        330  1.07  262.0   10.0    8.0    2.5   0.3
75% POWER  5360   75 %        10950   4050  382778 .011  865     29.0  1.976    32  2.20   23.0   55.0   11.0   57.0
NORMAL     7210   92 %        11565   5515  446030 .012 1009     40.2           23  2.50          85.0   10.0   80.0   0.1
NORMAL     7240   92 %        11570   5550  448878 .012 1015     40.4           22  2.50          80.0   10.0   79.0
NORMAL     7240   92 %        11569   5540  447997 .012 1010     40.4           21  2.50    5.0   75.0   11.0   78.0
MILITARY   8225  100 %        11890   6455  484985 .013 1120     46.2           20  2.70    4.0   90.0   10.0   90.0   0.1


EXHAUST EMISSION MASS DATA :

 TEST      --------------- #/# FUEL ---------------           ----------------- #/ MIN -----------------
 MODE
             CO      CO2     THC       NOX      ALD              CO       CO2      THC        NOX      ALD
                                      (NO2)   (HCHO)                                         (NO2)   (HCHO)

IDLE       0.06269  3.01  0.02080   .00371  0.00151          0.71556   34.42  0.23749    .04240  0.01719
IDLE       0.07564  2.98  0.02503   .00484                   0.88244   34.77  0.29200    .05650
IDLE       0.05915  3.01  0.02350   .00536  0.00006
75% POWER  0.00297  3.17  0.00107   .01004                   0.20018  214.11  0.07230    .67789
NORMAL     0.00188  3.18            .01229  0.00001          0.16553  292.84            1.12981  0.00081
NORMAL     0.00172  3.18            .01164                   0.15902  293.91            1.07731
NORMAL     0.00164  3.18  0.00020   .01113                   0.15115  293.33  0.01839   1.02801
MILITARY   0.00144  3.18  0.00015   .01199  0.00001          0.15538  341.83  0.01592   1.28975  0.02088
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SCOTT RESEARCH LABORATORIES                        SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                     DATE 10/27/71
                                                                                                          RUN T-009
                                                                                                 ENGINE  1,NUMBER  4


ENGINE TYPE AND MODEL: TF 30-P6C
ENGINE SERIAL # : P652063
ENGINE TOTAL TIME:  985.8 HRS.              TSMOH :        HRS.            TIME SINCE :
FUEL : JP-5                                                                   N1 COMPRESSOR OH :           HRS.
                                                                              N2 COMPRESSOR OH :           HRS.
                            START  FINISH           SAMPLE LINE :             COMBUSTOR CAN RPLC:          HRS.
INLET AIR TEMP.-DEG.F        86.0    86.5            MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:        HRS.
ATMOSPHERIC PRES.-IN.HG     30.08   30.05            MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :              HRS.
                                                     TEMP.:  230 DEG.F        N2 TURBINE OH :              HRS.
INLET AIR HUMIDITY: .0142 # H2O/# DRY AIR
RELATIVE HUMIDITY :  53%
                                                    PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2    FUEL     AIR CALC EXH    EXH    EPR   CO   CO2    THC     NO    NO2  C-NO   ALD
  MODE                   RPM    RPM    FLOW    FLOW  F/A TEMP  PRESS        DRY  DRY     WET    DRY   WET   DRY   WET
             #                         #/HR    #/HR      DEG.F IN.HG        PPM   %     PPMC    PPM   PPM   PPM   PPM

IDLE                                                 .009                   625  1.02  255.0    5.0   4.0
IDLE                                                 .009                   610  1.81  220.0   10.0   4.0    5.0
IDLE        600          3190   8430    700   74891 .009  955               622  1.86  225.0    2.5   4.0    2.5   5.9
75% POWER  5390   75 %   7586 12826   3120  259743 .012 1465   13.8          62  2.50   14.0   46.0   8.0   30.0   0.5
NORMAL     7156   92 %   8340 13365   4130  307862 .013 1635   18.8 1.641    38  2.80    9.0   65.0   9.0   60.0   0.5
MILITARY  11081  100 %   9990 14381   6810  425663 .016 1990   30.8 2.050    32  3.35    7.0  135.0   8.0  133.0   0.5

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------          ---------------- #/ MIN ----------------
  MODE
                CO     CO2      THC        NOX      ALD            CO       CO2      THC        NOX      ALD
                                          (NO2)    (HCHO)                                      (NO2)    (HCHO)

IDLE         0.06615  3.03  0.01369    .00159
IDLE         0.06514  3.04  0.01190    .00248
IDLE         0.06488  3.04  0.01190    .00114   0.00069        0.75691   35.46  0.13886    .01333   0.00801
75% POWER    0.00498  3.17  0.00058    .00720   0.00005        0.25899  164.86  0.02992    .37428   0.00235
NORMAL       0.00273  3.17  0.00033    .00883   0.00004        0.18821  218.53  0.02290    .60809   0.00280
MILITARY     0.00191  3.18  0.00022    .01423   0.00003        0.21712  360.52  0.02466   1.61465   0.00388
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SCOTT RESEARCH LABORATORIES
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES        SRL 1244-014-1171
                                                                                DATE 10/27/71
                                                                                   RUN T-010
                                                                          ENGINE  3.NUMBER  4

ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : 628305
ENGINE TOTAL TIME: 7394.5 HRS.
FUEL : JP-5                                TSMOH : 1073.5 HRS.          TIME SINCE :
                                                                          N1 COMPRESSOR OH :        10735 HRS.
                          START  FINISH                                   N2 COMPRESSOR OH :        10735 HRS.
INLET AIR TEMP.-DEG.F      73.5   76.0          SAMPLE LINE :             COMBUSTOR CAN RPLC:             HRS.
ATMOSPHERIC PRES.-IN.HG   30.03   30.06          MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:           HRS.
                                                 MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :           10737 HRS.
INLET AIR HUMIDITY: .0128 # H2O/# DRY AIR        TEMP.:  235 DEG.F        N2 TURBINE OH :           10737 HRS.
RELATIVE HUMIDITY :  70%

                                                PROBE USED : 3 HOLE JURY RIG


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

 TEST    THRUST  PWR     N1    N2    FUEL     AIR CALC EXH   EXH    EPR    CO   CO2    THC     NO    NO2  C-NO   ALD
 MODE                    RPM   RPM   FLOW    FLOW  F/A TEMP  PRESS         DRY  DRY    WET    DRY   WET   DRY   WET
           #                         #/HR    #/HR      DEG.F IN.HG         PPM   %     PPMC   PPM   PPM   PPM   PPM
IDLE
IDLE       540           2185  5912  1100 155924 .007                      675  1.36 1220.0   5.0   5.0
IDLE       510           2160  5874  1080 150370 .007  543                 645  1.29 1080.0   2.5   3.0   2.5   9.1
75% POWER 6320   75 %    5445  8740  5300 496769 .007  543                 640  1.31 1150.0   2.5   3.0   2.5
NORMAL    8420   92 %    5780  9050  6900 553574 .011  910   26.5 1.889     42  2.22          40.0   4.0  36.0   1.3
MILITARY  9450  100 %    5935  9220  7770 594193 .012 1040   35.7 2.199     34  2.60          60.0   6.0  56.0   1.2
MILITARY  9450  100 %    5935  9230  7770 607374 .013 1085   40.9 2.373     30  2.73          67.0   5.0  65.0   0.0
MILITARY  9420  100 %    5930  9240  7700 590952 .013 1085   40.8           29  2.67          64.0   4.0  64.0
                                                   .013 1070   40.7           31  2.72          63.0   3.0  64.0

EXHAUST EMISSION MASS DATA :

 TEST      --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
 MODE
             CO      CO2     THC      NOX      ALD           CO       CO2      THC       NOX      ALD
                                     (NO2)    (HCHO)                                    (NO2)    (HCHO)

IDLE       0.08813  2.78  0.08027   .00218
IDLE       0.08890  2.80  0.07490   .00126  0.00139
IDLE       0.08650  2.79  0.07830   .00124             1.62991    51.31  1.37322    .02317  0.02547
75% POWER  0.00379  3.17            .00659  0.00013    1.55830    50.24  1.40934    .02234
NORMAL     0.00261  3.18            .00847  0.00010    0.33507   280.30             .58213  0.01167
MILITARY   0.00225  3.18            .00880  0.00007    0.29990   365.24             .97462  0.01205
MILITARY   0.00222  3.18            .00848             0.29190   411.37            1.13966  0.00863
MILITARY   0.00233  3.18            .00806             0.28745   411.37            1.09794
                                                       0.29932   407.64            1.03429
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SCOTT RESEARCH LABORATORIES                         SRL 1244-014-1171                                    DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                             RUN T-011
                                                                                                    ENGINE  1.NUMBER  5


ENGINE TYPE AND MODEL: TF 30-P408
ENGINE SERIAL # : 664241
ENGINE TOTAL TIME:  740.4 HRS.         ,    TSMOH :        HRS.          TIME SINCE :
FUEL : JP-5                                                                N1 COMPRESSOR OH :              HRS.
                                                                           N2 COMPRESSOR OH :              HRS.
                             START  FINISH             SAMPLE LINE :       COMBUSTOR CAN RPLC:             HRS.
INLET AIR TEMP.-DEG.F         78.0    78.0              MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:     HRS.
ATMOSPHERIC PRES.-IN.HG      29.94   29.94              MAX TRANS TIME: 2.4 SEC   N1 TURBINE OH :          HRS.
                                                        TEMP.:  211 DEG.F         N2 TURBINE OH :          HRS.
INLET AIR HUMIDITY: .0154 # H20/# DRY AIR
RELATIVE HUMIDITY :  75%
                                                        PROBE USED : EPA J-52/TF 30


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1    N2    FUEL      AIR CALC EXH     EXH    EPR    CO   CO2     THC      NO    NO2  C-NO    ALD
  MODE                   RPM   RPM    FLOW     FLOW  F/A TEMP   PRESS          DRY  DRY     WET     DRY    WET   DRY    WET
             #                        #/HR     #/HR      DEG.F IN.HG          PPM   %     PPMC     PPM    PPM   PPM    PPM

IDLE                     3227  8635    795 130806 .006  960                    485  1.20   120.0    3.0    5.0   2.5    2.2
75% POWER  8023   75 %   8242 13300   4500 405595 .011 1645    24.1 1.025     36  2.31     4.0   48.0    8.0  49.0    0.4
NORMAL    10698   92 %   9070 14000   6210 463260 .013 1855    33.6 2.150     22  2.80     4.0   84.0    9.0  85.0    0.3
MILITARY  12417  100 %   9705 14468   7590 512248 .015 2035    40.0 2.368     20  3.10     4.0  130.0    8.0 132.0    0.4


EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------         ----------------- #/ MIN -----------------
  MODE
              CO      CO2      THC         NOX      ALD          CO        CO2      THC        NOX      ALD
                                          (NO2)   (HCHO)                                      (NO2)   (HCHO)

IDLE       0.07771   3.03  0.00970     .00215  0.00039       1.02962    40.10  0.12851     .02055  0.00519
75% POWER  0.00312   3.17  0.00018     .00812  0.00004       0.23416   238.10  0.01341     .60873  0.00295
NORMAL     0.00160   3.18  0.00015     .01108  0.00002       0.16520   328.83  0.01532    1.14766  0.00253
MILITARY   0.00131   3.10  0.00013     .01481  0.00003       0.16531   401.97  0.01694    1.87393  0.00373
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                                                                                    DATE 10/27/71
                                              SRL 1244-014-1171                          RUN T-012
SCOTT RESEARCH LABORATORIES                                                     ENGINE  1,NUMBER  6
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES


ENGINE TYPE AND MODEL: TF 30-P408                                      TIME SINCE :
ENGINE SERIAL # : 664371                      TSMOH :        HRS.        N1 COMPRESSOR OH :           HRS.
ENGINE TOTAL TIME: 1021.1 HRS.                                           N2 COMPRESSOR OH :           HRS.
FUEL : JP-5                                                              COMBUSTOR CAN RPLC:          HRS.
                                                  SAMPLE LINE :          NOZZLE GUIDE VANE OH:        HRS.
                             START  FINISH          MIN FLOW RATE: 16 LPM     N1 TURBINE OH :         HRS.
INLET AIR TEMP.-DEG.F         85.5    85.0         MAX TRANS TIME: 2.4 SEC   N2 TURBINE OH :          HRS.
ATMOSPHERIC PRES.-IN.HG      29.69   29.69         TEMP.:  210 DEG.F

INLET AIR HUMIDITY: .0173 # H2O/# DRY AIR
RELATIVE HUMIDITY :  66%                           PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :
                                                                                    CO    CO2     THC     NO    NO2   C-NO   ALD
                                   FUEL       AIR CALC EXH      EXH     EPR       DRY   DRY     WET    DRY    WET    DRY   WET
  TEST     THRUST  PWR    N1    N2   FLOW     FLOW  F/A TEMP    PRESS             PPM    %     PPMC    PPM    PPM    PPM   PPM
  MODE                   RPM   RPM  #/HR     #/HR       DEG.F IN.HG
             #
IDLE                     3228  8666   770 105174 .007   980                       540  1.44   260.0   11.0    1.0    8.0   5.2
75% POWER   8053   75 %  8269 13455  4375 364897 .012  1650    23.1 1.796          29  2.50     1.0   50.0    5.0   54.0   1.2
NORMAL     10656   92 %  9059 14077  5960 440030 .014  1850    32.2 2.109          21  2.83     1.0   90.0    4.0   91.0   1.2
MILITARY   12366  100 %  9647 14540  7230 488032 .015  2020    38.5 2.327          18  3.10     1.0  135.0    3.0  135.0   1.1


EXHAUST EMISSION MASS DATA :                                   ---------------- #/ MIN ----------------
              --------------- #/# FUEL ---------------
  TEST                                                            CO      CO2      THC       NOX      ALD
  MODE                                      NOX       ALD                                   (NO2)    (HCHO)
             CO       CO2      THC         (NO2)     (HCHO)

IDLE       0.07191   3.01   0.01757       .00262   0.00077     0.92282   38.63  0.22548    .03366  0.00993
75% POWER  0.00239   3.18   0.00004       .00736   0.00011     0.17412  231.60  0.00303    .53636  0.00800
NORMAL     0.00151   3.18   0.00004       .01106   0.00010     0.14990  315.64  0.00365   1.09833  0.00964
MILITARY   0.00117   3.18   0.00003       .01479   0.00008     0.14140  382.97  0.00405   1.78187  0.00980
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SCOTT RESEARCH LABORATORIES                           SRL 1244-014-1171                                          DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                                 RUN T-013
                                                                                                            ENGINE  3.NUMBER  5


ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : 628115
ENGINE TOTAL TIME: 3371.1 HRS.            TSMOH :        HRS.             TIME SINCE :
FUEL : JP-5                                                                  N1 COMPRESSOR OH :                 HRS.
                                                                             N2 COMPRESSOR OH :                 HRS.
                             START  FINISH         SAMPLE LINE :             COMBUSTOR CAN RPLC:                HRS.
INLET AIR TEMP.-DEG.F         83.0    83.5          MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:              HRS.
ATMOSPHERIC PRES.-IN.HG      29.85   29.86          MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :                    HRS.
                                                    TEMP.:  205 DEG.F        N2 TURBINE OH :                    HRS.
INLET AIR HUMIDITY: .0111 # H2O/# DRY AIR
RELATIVE HUMIDITY :  46%
                                                    PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST     THRUST   PWR     N1     N2    FUEL      AIR CALC EXH     EXH    EPR    CO   CO2     THC     NO    NO2  C-NO    ALD
  MODE                     RPM    RPM    FLOW     FLOW  F/A TEMP   PRESS          DRY  DRY     WET    DRY   WET   DRY    WET
             #                           #/HR     #/HR      DEG.F IN.HG           PPM   %     PPMC    PPM   PPM   PPM    PPM

IDLE                              5957                 .005                       582  1.00  583.0   11.0   2.0   7.0    8.9
75% POWER   6076   75 %   5465    8915   5130 507517 .010  940    23.4 1.791     53  2.10    7.0   38.0   7.0  39.0    1.0
NORMAL      8063   92 %   5800    9215   6630 561707 .012 1050    32.3 2.092     34  2.46    2.0   68.0   4.0  61.0    0.3
MILITARY          100 %           9401                 .013 1140    30.7           35  2.64    2.0   79.0   4.0  81.0    0.2

EXHAUST EMISSION MASS DATA :

  TEST      --------------- #/# FUEL ---------------          ---------------- #/ MIN ----------------
  MODE
             CO      CO2     THC       NOX     ALD              CO       CO2      THC        NOX     ALD
                                      (NO2)   (HCHO)                                         (NO2)   (HCHO)

IDLE       0.10550  2.04  0.05294   .00389  0.00178
75% POWER  0.00509  3.17  0.00034   .00716  0.00011          0.43560  271.12  0.02910    .61179  0.00915
NORMAL     0.00283  3.10  0.00000   .00973  0.00003          0.31223  350.00  0.00921   1.07562  0.00304
MILITARY   0.00272  3.18  0.00000   .01044  0.00002
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SCOTT RESEARCH LABORATORIES                         SPL 1244-014-1171                                  DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                       RUN T-014
                                                                                                ENGINE  1,NUMBER  7


ENGINE TYPE AND MODEL: TF 30-P408
ENGINE SERIAL # : 671490
ENGINE TOTAL TIME:  626.3 HRS.            TSMOH :        HRS.          TIME SINCE :
FUEL : JP-5                                                               N1 COMPRESSOR OH :             HRS.
                                                                          N2 COMPRESSOR OH :             HRS.
                            START  FINISH           SAMPLE LINE :         COMBUSTOR CAN RPLC:            HRS.
INLET AIR TEMP.-DEG.F        80.5    82.0            MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:      HRS.
ATMOSPHERIC PRES.-IN.HG     29.89   29.89            MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :            HRS.
                                                     TEMP.:  205 DEG.F        N2 TURBINE OH :            HRS.
INLET AIR HUMIDITY: .0147 # H2O/# DRY AIR
RELATIVE HUMIDITY :  64%
                                                     PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1    N2   FUEL    AIR CALC EXH    EXH    EPR    CO   CO2    THC    NO   NO2  C-NO   ALD
  MODE                   RPM   RPM   FLOW   FLOW  F/A TEMP  PRESS          DRY  DRY    WET   DRY   WET   DRY   WET
            #                        #/HR   #/HR     DEG.F IN.HG           PPM   %     PPMC  PPM   PPM   PPM   PPM

IDLE        780          3272  8713   780  97826 .008                      535  1.50  231.0  10.0   1.0  10.0   0.5
MILITARY  12060  100 %   9721 14524  7420 463987 .016                       22  3.35    3.0 158.0   3.0 166.0   0.5

EXHAUST EMISSION MASS DATA :

  TEST     --------------- #/# FUEL ---------------        ---------------- #/ MIN ----------------
  MODE
              CO     CO2     THC       NOX     ALD             CO      CO2      THC       NOX      ALD
                                      (NO2)   (HCHO)                                     (NO2)    (HCHO)

IDLE       0.06524  3.03  0.01427   .00221  0.00116         0.84807   39.41  0.18553   .02873  0.01503
MILITARY   0.00134  3.18  0.00009   .01597  0.00003         0.16567  392.98  0.01152  1.97514  0.00423
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SCOTT RESEARCH LABORATORIES                         SRL 1244-014-1171                                  DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                       RUN T-015
                                                                                                  ENGINE  3,NUMBER  6

ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : P606907
ENGINE TOTAL TIME: 3415.0 HRS.              TSMOH :  585.6 HRS.            TIME SINCE :
FUEL : JP-5                                                                   N1 COMPRESSOR OH :          5856 HRS.
                                                                              N2 COMPRESSOR OH :          5856 HRS.
                              START  FINISH            SAMPLE LINE :          COMBUSTOR CAN RPLC:              HRS.
INLET AIR TEMP.-DEG.F          84.0    84.5             MIN FLOW RATE: 16 LPM NOZZLE GUIDE VANE OH:            HRS.
ATMOSPHERIC PRES.-IN.HG       29.87   29.87             MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :            5856 HRS.
                                                        TEMP.:  230 DEG.F     N2 TURBINE OH :             5856 HRS.
INLET AIR HUMIDITY: .0163 # H2O/# DRY AIR
RELATIVE HUMIDITY :  64%
                                                       PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2    FUEL      AIR CALC EXH    EXH    EPR    CO    CO2     THC     NO    NO2  C-NO    ALD
  MODE                    RPM    RPM   FLOW     FLOW  F/A TEMP  PRESS          DRY   DRY     WET    DRY    WET   DRY    WET
            #                          #/HR     #/HR      DEG.F IN.HG          PPM    %     PPMC    PPM    PPM   PPM    PPM

IDLE        430          2150   5900   1060 167231 .006  573                   590  1.14 1140.0    7.0    1.5   7.0   18.9
75% POWER  6080   75 %   5500   8921   5030 500435 .010  885    24.0 1.813     36  2.09     4.7   30.0    3.0  36.0    1.5
NORMAL     7940   92 %   5820   9218   6450 551033 .012  990    32.4 2.097     27  2.44     2.0   43.0    3.0  56.0    1.1
MILITARY   9420  100 %   6060   9455   7680 573004 .013 1075    39.0 2.321     20  2.80     2.0   67.0    3.0  75.0    0.2

EXHAUST EMISSION MASS DATA :

  TEST         --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
                 CO     CO2     THC        NOX      ALD            CO       CO2      THC        NOX      ALD
                                          (NO2)    (HCHO)                                      (NO2)    (HCHO)

IDLE          0.09045  2.75  0.00037    .00214  0.00322         1.59799    48.63  1.56123    .03790  0.05697
75% POWER     0.00343  3.17  0.00023    .00525  0.00016         0.28785   266.08  0.01937    .43953  0.01361
NORMAL        0.00227  3.18  0.00008    .00628  0.00010         0.24351   341.45  0.00912    .67547  0.01104
MILITARY      0.00144  3.18  0.00007    .00830  0.00002         0.18488   406.73  0.00947   1.06305  0.00209
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SCOTT RESEARCH LABORATORIES                            SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                  DATE 10/27/71
                                                                                                      RUN T-016
                                                                                              ENGINE  2.NUMBER  3

ENGINE TYPE AND MODEL: J 52-P8A
ENGINE SERIAL # : P661536
ENGINE TOTAL TIME:  368.5 HRS.              TSMOH :  242.0 HRS.          TIME SINCE :
FUEL : JP-5                                                                 N1 COMPRESSOR OH :         3685 HRS.
                                                                            N2 COMPRESSOR OH :         3685 HRS.
                              START  FINISH          SAMPLE LINE :          COMBUSTOR CAN RPLC:        3685 HRS.
INLET AIR TEMP.-DEG.F          74.0    74.0           MIN FLOW RATE: 16 LPM NOZZLE GUIDE VANE OH:      3685 HRS.
ATMOSPHERIC PRES.-IN.HG       29.74   29.75           MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :          3685 HRS.
                                                      TEMP.:  223 DEG.F     N2 TURBINE OH :            6241 HRS.
INLET AIR HUMIDITY: .0169 # H2O/# DRY AIR
RELATIVE HUMIDITY :  93%
                                                      PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR    N1     N2    FUEL     AIR CALC EXH     EXH    EPR    CO    CO2     THC     NO    NO2  C-NO   ALD
  MODE                  RPM    RPM    FLOW    FLOW  F/A TEMP   PRESS          DRY   DRY     WET    DRY   WET   DRY   WET
           #                          #/HR    #/HR      DEG.F  IN.HG          PPM    %     PPMC    PPM   PPM   PPM   PPM
IDLE                                                .005
75% POWER  5920   75 %         11106  4420 389411 .011  895    32.0 2.090     330  1.07            8.0   1.0   8.0   2.1
NORMAL     7720   92 %         11620  5915 433263 .014 1048    42.6            70  2.36     9.0   35.0   8.0  39.0   0.7
MILITARY   8620  100 %         11909  6800 463308 .015 1140    47.9            50  2.85           57.0   3.0  60.0   0.6
                                                                               26  3.07     0.5   80.0   3.0  85.0   0.5

EXHAUST EMISSION MASS DATA :

  TEST     --------------- #/# FUEL ---------------         ----------------- #/ MIN -----------------
  MODE
             CO      CO2     THC        NOX      ALD             CO       CO2      THC        NOX      ALD
                                       (NO2)    (HCHO)                                       (NO2)    (HCHO)
IDLE
75% POWER  0.00601  3.17  0.00039    .00608  0.00007         0.44243  233.48  0.02893    .44805  0.00495
NORMAL     0.00352  3.17             .00701  0.00005         0.34668  312.96             .69072  0.00474
MILITARY   0.00174  3.18  0.00002    .00900  0.00004         0.19754  360.10  0.00192  1.02034  0.00423
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SCOTT RESEARCH LABORATORIES                       SRL 1244-014-1171                                        DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                             RUN T-017
                                                                                                   ENGINE  1,NUMBER  8


ENGINE TYPE AND MODEL: TF 30-P6C
ENGINE SERIAL # : P659159
ENGINE TOTAL TIME: 1102.6 HRS.             TSMOH :         HRS.           TIME SINCE :
FUEL : JP-5                                                                  N1 COMPRESSOR OH :             HRS.
                                                                             N2 COMPRESSOR OH :             HRS.
                               START  FINISH             SAMPLE LINE :       COMBUSTOR CAN RPLC:            HRS.
INLET AIR TEMP.-DEG.F           83.5    84.0              MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:    HRS.
ATMOSPHERIC PRES.-IN.HG        29.83   29.83              MAX TRANS TIME: 2.4 SEC   N1 TURBINE OH :          HRS.
                                                          TEMP.:  228 DEG.F          N2 TURBINE OH :          HRS.
INLET AIR HUMIDITY: .0174 # H2O/# DRY AIR
RELATIVE HUMIDITY :  69%
                                                          PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2    FUEL      AIR CALC EXH     EXH    EPR    CO   CO2     THC     NO   NO2  C-NO    ALD
  MODE                   RPM    RPM    FLOW     FLOW  F/A TEMP   PRESS          DRY  DRY     WET    DRY   WET   DRY    WET
            #                          #/HR     #/HR      DEG.F  IN.HG          PPM   %      PPMC   PPM   PPM   PPM    PPM

IDLE        640          3129   8267    665 154472 .004  912                    302  0.85   111.0    6.0   1.0   4.0    1.7
75% POWER  5781   75 %   7703  12735   3260 275802 .012 1470    14.9 1.511      70  2.46     1.0   35.0   8.0  38.0    0.5
NORMAL     7618   92 %   8454  13266   4320 324314 .013 1635    20.5 1.704      46  2.70     0.5   53.0   4.0  61.0    0.8
MILITARY  11050  100 %   9825  14300   6895 403833 .017 1988    31.5            33  3.58     1.0  130.0   4.0 132.0    0.5

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
              CO     CO2      THC        NOX      ALD             CO       CO2       THC       NOX      ALD
                                        (NO2)    (HCHO)                                        (NO2)    (HCHO)

IDLE       0.06846  3.03  0.01271     .00263  0.00043         0.75877    33.60   0.14089    .02913  0.00475
75% POWER  0.00569  3.17  0.00004     .00583  0.00005         0.30924   172.29   0.00228    .31714  0.00251
NORMAL     0.00338  3.17  0.00002     .00684  0.00007         0.24336   228.58   0.00135    .49249  0.00474
MILITARY   0.00187  3.18  0.00003     .01247  0.00003         0.21436   365.10   0.00337   1.43249  0.00370
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SCOTT RESEARCH LABORATORIES                          SRL 1244-014-1171                                   DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                            RUN T-018
                                                                                                     ENGINE  1,NUMBER  9

ENGINE TYPE AND MODEL: TF 30-P408
ENGINE SERIAL # : P671484
ENGINE TOTAL TIME:  389.8 HRS.             TSMOH :        HRS.            TIME SINCE :
FUEL : JP-5                                                                 N1 COMPRESSOR OH :               HRS.
                                                                            N2 COMPRESSOR OH :               HRS.
                          START  FINISH          SAMPLE LINE :              COMBUSTOR CAN RPLC:              HRS.
INLET AIR TEMP.-DEG.F      79.0   80.0            MIN FLOW RATE: 16 LPM     NOZZLE GUIDE VANE OH:            HRS.
ATMOSPHERIC PRES.-IN.HG   29.82   29.83           MAX TRANS TIME: 2.4 SEC   N1 TURBINE OH :                  HRS.
                                                  TEMP.:  230 DEG.F         N2 TURBINE OH :                  HRS.
INLET AIR HUMIDITY: .0160 # H2O/# DRY AIR
RELATIVE HUMIDITY :  74%
                                                  PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1    N2    FUEL     AIR CALC EXH    EXH    EPR     CO   CO2     THC     NO    NO2  C-NO    ALD
  MODE                   RPM   RPM    FLOW    FLOW  F/A TEMP   PRESS          DRY  DRY     WET    DRY    WET   DRY    WET
             #                        #/HR    #/HR      DEG.F  IN.HG          PPM   %      PPMC   PPM    PPM   PPM    PPM

IDLE        795          3252  8688    785 100272 .008  974                   530  1.55  233.0   11.0    3.0  10.0   10.1
75% POWER  7827   75 %   8282 13365   4375 311923 .014 1625    23.2 1.795      42  2.93    1.0   54.0    8.0  57.0    0.4
NORMAL    10583   92 %   9087 14027   6000 404908 .015 1840    32.8 2.118      26  3.10    0.5  108.0    7.0 102.0    0.5
MILITARY  12264  100 %   9670 14497   7330 479460 .015 2015    39.2 2.342      25  3.20    1.0  139.0    4.0 143.0    0.5

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------         ----------------- #/ MIN -----------------
  MODE
               CO     CO2     THC        NOX     ALD                CO       CO2      THC        NOX      ALD
                                        (NO2)   (HCHO)                                           (NO2)    (HCHO)

IDLE        0.06585  3.03  0.01467    .00289  0.00140         0.06157    39.63  0.19199     .03782  0.01832
75% POWER   0.00291  3.18  0.00004    .00707  0.00003         0.21201   231.54  0.00258     .51548  0.00227
NORMAL      0.00173  3.18  0.00002    .01238  0.00004         0.17252   317.73  0.00168    1.23801  0.00370
MILITARY    0.00161  3.18  0.00003    .01489  0.00004         0.19631   388.18  0.00398    1.81950  0.00438
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SCOTT RESEARCH LABORATORIES                               SRL 1244-014-1171
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                     DATE 10/27/71
                                                                                                          RUN T-019
                                                                                                 ENGINE  3.NUMBER  7

ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : P626995
ENGINE TOTAL TIME: 5141.3 HRS.               TSMOH :         HRS.            TIME SINCE :
FUEL : JP-5                                                                    N1 COMPRESSOR OH :            HRS.
                            START  FINISH                                      N2 COMPRESSOR OH :            HRS.
INLET AIR TEMP.-DEG.F        79.0   76.0          SAMPLE LINE :                COMBUSTOR CAN RPLC:           HRS.
ATMOSPHERIC PRES.-IN.HG     29.96  29.90           MIN FLOW RATE: 16 LPM       NOZZLE GUIDE VANE OH:         HRS.
                                                   MAX TRANS TIME: 2.4 SEC     N1 TURBINE OH :               HRS.
INLET AIR HUMIDITY: .0151 # H2O/# DRY AIR          TEMP.:  240 DEG.F           N2 TURBINE OH :               HRS.
RELATIVE HUMIDITY :  75%
                                                  PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1    N2   FUEL      AIR CALC EXH    EXH    EPR    CO   CO2     THC     NO   NO2  C-NO   ALD
  MODE                   RPM   RPM   FLOW     FLOW  F/A TEMP  PRESS          DRY  DRY     WET    DRY   WET   DRY   WET
            #                        #/HR     #/HR      DEG.F IN.HG          PPM   %     PPMC    PPM   PPM   PPM   PPM
IDLE
                                                   .006                      590  1.13 1170.0    9.0   1.0   8.0   4.1
75% POWER  6430   75 %  5535  8928   5120 506810  .010  880   25.0 1.844      45  2.10    3.0   37.0   5.0  40.0   2.0
NORMAL     8210   92 %  5800  9210   6510 524273  .012  995   33.2 2.121      33  2.59    1.0   53.0   4.0  60.0   0.9
MILITARY   9530  100 %  6000  9415   7560 573984  .013 1070   39.3 2.328      30  2.75    0.3   68.0   4.0  77.0   0.5

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
               CO     CO2     THC        NOX     ALD             CO        CO2      THC        NOX      ALD
                                        (NO2)   (HCHO)                                        (NO2)    (HCHO)

IDLE        0.09111  2.74  0.09119    .00255  0.00070
75% POWER   0.00432  3.17  0.00015    .00667  0.00022
NORMAL      0.00254  3.18  0.00004    .00733  0.00008        0.36859   270.75  0.01252    .56893  0.01837
MILITARY    0.00225  3.18  0.00001    .00873  0.00004        0.27522   344.60  0.00432    .79490  0.00856
                                                             0.28300   400.24  0.00143   1.09980  0.00523
```

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SCOTT RESEARCH LABORATORIES                 SRL 1244-014-1171                                              DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                             RUN T-020
                                                                                                         ENGINE  3.NUMBER  8


ENGINE TYPE AND MODEL: J 57-P10
ENGINE SERIAL # : P604897
ENGINE TOTAL TIME: 4146.0 HRS.           TSMOH :        HRS.            TIME SINCE :
FUEL : JP-5                                                               N1 COMPRESSOR OH :                 HRS.
                                                                          N2 COMPRESSOR OH :                 HRS.
                          START  FINISH           SAMPLE LINE :           COMBUSTOR CAN RPLC:                HRS.
INLET AIR TEMP.-DEG.F      78.0    80.0            MIN FLOW RATE: 16 LPM   NOZZLE GUIDE VANE OH:              HRS.
ATMOSPHERIC PRES.-IN.HG   30.12   30.14            MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :                    HRS.
                                                   TEMP.:  220 DEG.F       N2 TURBINE OH :                    HRS.
INLET AIR HUMIDITY: .0131 # H2O/# DRY AIR
RELATIVE HUMIDITY :  62%
                                                   PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR    N1    N2    FUEL     AIR CALC EXH    EXH   EPR    CO   CO2    THC    NO   NO2  C-NO  ALD
  MODE                  RPM   RPM    FLOW    FLOW  F/A TEMP  PRESS         DRY  DRY    WET   DRY   WET   DRY  WET
            r                        #/HR    #/HR      DEG.F IN.HG         PPM   %    PPMC   PPM   PPM   PPM  PPM

IDLE        470         2135  5926   1070  158813 .007  575                620  1.21 1240.0  10.0   1.5        1.6
75% POWER  6185   75 %  5465  8860   5850  534506 .009  915   24.3 1.015    58  1.96   13.0  28.0   3.0        0.7
NORMAL     8161   92 %  5800  9173   6510  591741 .011 1040   33.1 2.109    39  2.29    4.0  50.0   3.0        0.5
MILITARY   9507  100 %  6010  9381   7600  619125 .012 1120   39.1 2.311    32  2.56    2.0  60.0   3.0        0.5

EXHAUST EMISSION MASS DATA :

  TEST     --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
              CO     CO2     THC       NOX      ALD            CO       CO2      THC        NOX      ALD
                                      (NO2)    (HCHO)                                      (NO2)    (HCHO)

IDLE       0.00968  2.75  0.09022    .00275  0.00026        1.59924    49.01  1.60087    .04904  0.00457
75% POWER  0.00601  3.17  0.00068    .00527  0.00008        0.50551   266.68  0.05712    .44341  0.00677
NORMAL     0.00341  3.17  0.00018    .00771  0.00005        0.37027   344.40  0.01949    .83683  0.00536
MILITARY   0.00256  3.18  0.00008    .00921  0.00004        0.32391   402.27  0.01017   1.16555  0.00560
```

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SCOTT RESEARCH LABORATORIES                  SRL 1244-014-1171                                          DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                          RUN T-021
                                                                                                  ENGINE  1,NUMBER 10


ENGINE TYPE AND MODEL: TF 30-P0B
ENGINE SERIAL # : P664169
ENGINE TOTAL TIME:  990.8 HRS.            TSMOH :  990.8 HRS.          TIME SINCE :
FUEL : JP-5                                                              N1 COMPRESSOR OH :        5523 HRS.
                                                                         N2 COMPRESSOR OH :        2608 HRS.
                            START  FINISH            SAMPLE LINE :       COMBUSTOR CAN RPLC:       5623 HRS.
INLET AIR TEMP.-DEG.F        77.0    77.0             MIN FLOW RATE: 16 LPM   NOZZLE GUIDE VANE OH:       HRS.
ATMOSPHERIC PRES.-IN.HG     30.11   30.11             MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :          2608 HRS.
                                                      TEMP.:  230 DEG.F    N2 TURBINE OH :          2608 HRS.
INLET AIR HUMIDITY: .0117 # H2O/# DRY AIR
RELATIVE HUMIDITY :  60%
                                                      PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2    FUEL     AIR CALC EXH    EXH    EPR    CO   CO2    THC     NO   NO2  C-NO   ALD
  MODE                   RPM    RPM    FLOW    FLOW  F/A TEMP  PRESS          DRY  DRY    WET    DRY  WET   DRY   WET
            #                          #/HR    #/HR      DEG.F IN.HG          PPM   %     PPMC   PPM  PPM   PPM   PPM

IDLE       650          3040   8460    700 208522 .003  915                   285  0.65  158.0    4.0   3.0          3.1
75% POWER  6261   75 %  7810  13160   3440 311613 .011 1505   15.2 1.518      23  2.30    0.3   70.0   7.0          0.9
NORMAL     8313   92 %  8535  13685   4570 347064 .013 1670   20.7 1.705      22  2.75    1.0  113.0   8.0          1.1
MILITARY  11396  100 %  9660  14505   6680 430398 .016 1930   30.3 2.033      19  3.25    2.0  177.0   6.0          1.6

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
                CO     CO2      THC        NOX      ALD            CO      CO2       THC       NOX      ALD
                                          (NO2)    (HCHO)                                     (NO2)    (HCHO)

IDLE         0.00352  2.97   0.02311    .00340   0.00100       0.97440   34.70  0.26958    .03973  0.01164
75% POWER    0.00201  3.18   0.00001    .01115   0.00009       0.11530  182.14  0.00077    .63933  0.00506
NORMAL       0.00161  3.18   0.00004    .01465   0.00009       0.12297  242.02  0.00285   1.11596  0.00690
MILITARY     0.00118  3.18   0.00006    .01875   0.00011       0.13116  353.82  0.00709   2.08656  0.01249
```

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SCOTT RESEARCH LABORATORIES                          SRL 1244-014-1171                                        DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                              RUN T-022
                                                                                                      ENGINE  1.NUMBER 11


ENGINE TYPE AND MODEL: TF 30-P6C
ENGINE SERIAL # : P651947
ENGINE TOTAL TIME:  976.2 HRS.          TSMOH :  274.6 HRS.           TIME SINCE :
FUEL : JP-5                                                              N1 COMPRESSOR OH :          2746 HRS.
                                                                         N2 COMPRESSOR OH :          2746 HRS.
                             START  FINISH          SAMPLE LINE :        COMBUSTOR CAN RPLC:              HRS.
INLET AIR TEMP.-DEG.F         74.0    75.0           MIN FLOW RATE: 16 LPM  NOZZLE GUIDE VANE OH:          HRS.
ATMOSPHERIC PRES.-IN.HG      30.05   30.05           MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :        2746 HRS.
                                                     TEMP.:  225 DEG.F      N2 TURBINE OH :               HRS.
INLET AIR HUMIDITY: .0162 # H2O/# DRY AIR
RELATIVE HUMIDITY :  89%
                                                    PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST     THRUST  PWR     N1     N2    FUEL      AIR CALC EXH     EXH    EPR    CO    CO2     THC     NO    NO2  C-NO    ALD
  MODE                     RPM    RPM   FLOW     FLOW  F/A TEMP   PRESS          DRY   DRY     WET    DRY    WET   DRY    WET
              #                         #/HR     #/HR      DEG.F IN.HG           PPM    %      PPMC   PPM    PPM   PPM    PPM

IDLE         670          3186   8369    700 175540 .004  920                    314  0.70   139.0    2.0    1.0           2.6
75% POWER   6046   75 %   7790  12878   3420 297735 .011 1470    15.0 1.539       66  2.39     1.0   40.0    0.0           0.7
NORMAL      8024   92 %   8575  13485   4570 338329 .014 1640    21.4 1.731       43  2.82     0.3   62.0    5.0           1.1
MILITARY   11160  100 %   9720  14348   6810 417165 .016 1945    30.9 2.054       34  3.42     0.3  125.0    4.0           1.2

EXHAUST EMISSION MASS DATA :

  TEST        --------------- #/# FUEL ----------------        ----------------- #/ MIN -----------------
  MODE
               CO      CO2     THC       NOX     ALD            CO       CO2      THC       NOX      ALD
                                        (NO2)   (HCHO)                                     (NO2)    (HCHO)

IDLE        0.07745   3.00   0.01724   .00122  0.00071       0.90361    35.03  0.20112    .01416  0.00828
75% POWER   0.04558   3.17   0.00004   .00670  0.00007       0.31784   180.76  0.00246    .38210  0.00378
NORMAL      0.00318   3.10   0.00001   .00793  0.00009       0.23633   241.84  0.00084    .60416  0.00679
MILITARY    0.00201   3.10   0.00001   .01256  0.00008       0.22804   360.58  0.00104   1.42593  0.00916
```

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SCOTT RESEARCH LABORATORIES                      SRL 1244-014-1171                                    DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                      RUN T-023
                                                                                                 ENGINE  1.NUMBER 12


ENGINE TYPE AND MODEL: TF 30-P8
ENGINE SERIAL # : P664444
ENGINE TOTAL TIME:  967.1 HRS.               TSMOH :  967.1 HRS.              TIME SINCE :
FUEL : JP-5                                                                      N1 COMPRESSOR OH :       9671 HRS.
                                                                                 N2 COMPRESSOR OH :       9671 HRS.
                               START  FINISH              SAMPLE LINE :          COMBUSTOR CAN RPLC:      9671 HRS.
INLET AIR TEMP.-DEG.F           86.5    86.5               MIN FLOW RATE: 16 LPM  NOZZLE GUIDE VANE OH:    9671 HRS.
ATMOSPHERIC PRES.-IN.HG        29.86   29.86               MAX TRANS TIME: 2.4 SEC N1 TURBINE OH :         9671 HRS.
                                                          TEMP.:  225 DEG.F      N2 TURBINE OH :          9671 HRS.
INLET AIR HUMIDITY: .0173 # H20/# DRY AIR
RELATIVE HUMIDITY :  64%
                                                           PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR    N1     N2    FUEL      AIR CALC EXH    EXH    EPR    CO   CO2     THC     NO   NO2  C-NO   ALD
  MODE                  RPM    RPM    FLOW     FLOW  F/A TEMP  PRESS          DRY  DRY     WET    DRY   WET   DRY   WET
            #                         #/HR     #/HR      DEG.F IN.HG          PPM   %     PPMC    PPM   PPM   PPM   PPM

IDLE                                               .004                        360  0.79   187.0    2.0   1.0          5.7
NORMAL     7953  92 %  8465 13570  4360 343430 .013 1655    19.6 1.673   22  2.65     1.0   85.0   3.0          0.5
MILITARY  11237 100 %  9640 14405  6520 433355 .015 1915    29.5 2.012    9  3.15     1.0  150.0   3.0          0.2

EXHAUST EMISSION MASS DATA :

  TEST       --------------- #/# FUEL ---------------         ----------------- #/ MIN -----------------
  MODE
                CO     CO2     THC        NOX     ALD              CO      CO2      THC        NOX     ALD
                                         (NO2)   (HCHO)                                       (NO2)   (HCHO)

IDLE         0.00633  2.97  0.02265    .00119  0.00152
NORMAL       0.00169  3.18  0.00004    .01107  0.00004         0.12293  230.89  0.00285    .00396  0.00314
MILITARY     0.00054  3.18  0.00003    .01617  0.00001         0.05922  345.47  0.00368   1.75721  0.00159
```

```
SCOTT RESEARCH LABORATORIES                           SRL 1244-014-1171                                    DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                          RUN T-024
                                                                                                  ENGINE  1.NUMBER 13


ENGINE TYPE AND MODEL: TF 30-P408
ENGINE SERIAL # : P664193                                                         TIME SINCE :
ENGINE TOTAL TIME:  587.9 HRS.              TSMOH :        HRS.                     N1 COMPRESSOR OH :          HRS.
FUEL : JP-5                                                                         N2 COMPRESSOR OH :          HRS.
                            START  FINISH            SAMPLE LINE :                  COMBUSTOR CAN RPLC:         HRS.
INLET AIR TEMP.-DEG.F        83.0    83.0              MIN FLOW RATE: 16 LPM        NOZZLE GUIDE VANE OH:       HRS.
ATMOSPHERIC PRES.-IN.HG     29.93   29.93              MAX TRANS TIME: 2.4 SEC      N1 TURBINE OH :             HRS.
                                                       TEMP.:  260 DEG.F            N2 TURBINE OH :             HRS.
INLET AIR HUMIDITY: .0168 # H2O/# DRY AIR
RELATIVE HUMIDITY :  69%                              PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

 TEST    THRUST  PWR     N1    N2   FUEL     AIR CALC EXH    EXH   EPR    CO   CO2    THC    NO   NO2  C-NO   ALD
 MODE                   RPM   RPM   FLOW    FLOW  F/A TEMP  PRESS         DRY  DRY    WET   DRY   WET  DRY    WET
                                    #/HR    #/HR     DEG.F IN.HG          PPM   %    PPMC   PPM   PPM  PPM    PPM
           #

IDLE                    3230  8665   775   96392 .008  984                540  1.59  265.0  12.0  2.0          0.0
75% POWER  7714   75 %  8243 13401  4310  323604 .013 1655   22.5 1.769    42  2.70    1.0  58.0  5.0          0.1
NORMAL    10348   92 %  9082 14865  5970  394099 .015 1883   31.6 2.080    28  3.17    1.0 102.0  3.0
MILITARY  12090  100 %  9687 14543  7210  431873 .017 2055   38.1 2.302    24  3.50    0.5 160.0  4.0          0.3

EXHAUST EMISSION MASS DATA :

 TEST       --------------- #/# FUEL ---------------         ----------------- #/ MIN -----------------
 MODE
             CO      CO2      THC       NOX      ALD            CO       CO2      THC       NOX      ALD
                                       (NO2)    (HCHO)                                     (NO2)    (HCHO)

IDLE        0.06546  3.02  0.01633   .00281  0.00011        0.84559   39.07  0.21098   .03627  0.00140
75% POWER   0.00397  3.18  0.00004   .00757  0.00001        0.22075  228.08  0.00269   .54399  0.00059
NORMAL      0.00176  3.18  0.00003   .01103                 0.17494  316.14  0.00328  1.09763
MILITARY    0.00141  3.18  0.00001   .01561  0.00002        0.16980  381.87  0.00180  1.87601  0.00237
```

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SCOTT RESEARCH LABORATORIES                        SRL 1244-014-1171                                       DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                            RUN T-025
                                                                                                     ENGINE  2.NUMBER  4


ENGINE TYPE AND MODEL: J 52-P6A
ENGINE SERIAL # : 636689
ENGINE TOTAL TIME: 1309.5 HRS.                TSMOH :  327.9 HRS.               TIME SINCE :
FUEL : JP-5                                                                         N1 COMPRESSOR OH :       3279 HRS.
                                                                                    N2 COMPRESSOR OH :       3279 HRS.
                             START  FINISH           SAMPLE LINE :                  COMBUSTOR CAN RPLC:           HRS.
INLET AIR TEMP.-DEG.F         78.5    82.0            MIN FLOW RATE: 16 LPM         NOZZLE GUIDE VANE OH:         HRS.
ATMOSPHERIC PRES.-IN.HG      30.06   30.06            MAX TRANS TIME: 2.4 SEC       N1 TURBINE OH :          3279 HRS.
                                                      TEMP.:  260 DEG.F             N2 TURBINE OH :          3279 HRS.
INLET AIR HUMIDITY: .0176 # H2O/# DRY AIR
RELATIVE HUMIDITY :  80%
                                                      PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1      N2    FUEL      AIR CALC EXH      EXH     EPR    CO   CO2     THC     NO    NO2  C-NO    ALD
  MODE                   RPM     RPM    FLOW     FLOW  F/A TEMP    PRESS          DRY   DRY     WET    DRY    WET   DRY    WET
             #                          #/HR     #/HR      DEG.F IN.HG            PPM    %     PPMC    PPM    PPM   PPM    PPM

IDLE        490                   6742    750 114190 .007  520                    605  1.20   221.0           1.0            2.4
75% POWER  5200   75 %            1073   3970 360062 .011  845    26.3 1.891      90  2.29     4.0           2.0            0.4
NORMAL     6900   92 %           11202   5315 346248 .015  983    35.9 2.215      57  3.21     1.0           2.0            0.5
MILITARY   8840  100 %           11582   6340 377534 .017 1085    42.1 2.426      34  3.52     0.5           2.0            0.3

EXHAUST EMISSION MASS DATA :

  TEST     --------------- #/# FUEL ---------------      ---------------- #/ MIN ----------------
  MODE
               CO     CO2      THC        NOX     ALD          CO      CO2      THC        NOX     ALD
                                         (NO2)   (HCHO)                                   (NO2)   (HCHO)

IDLE       0.08974  2.99  0.01662              0.00040      1.12175   37.32  0.20771              0.00496
75% POWER  0.00795  3.17  0.00018              0.00004      0.52607  209.55  0.01191              0.00262
NORMAL     0.00360  3.17  0.00003              0.00004      0.31891  281.19  0.00287              0.00316
MILITARY   0.00195  3.18  0.00001              0.00002      0.20653  335.70  0.00157              0.00207
```

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SCOTT RESEARCH LABORATORIES                       SRL 1244-014-1171                                         DATE 10/27/71
AIRCRAFT EMISSIONS BASELINE DATA - TURBINE ENGINES                                                              RUN T-026
                                                                                                     ENGINE  2.NUMBER  5


ENGINE TYPE AND MODEL: J 52-P8A
ENGINE SERIAL # : 661138
ENGINE TOTAL TIME:  884.2 HRS.          TSMOH :  511.2 HRS.          TIME SINCE :
FUEL : JP-5                                                             N1 COMPRESSOR OH :        7803 HRS.
                                                                        N2 COMPRESSOR OH :        6481 HRS.
                             START  FINISH          SAMPLE LINE :       COMBUSTOR CAN RPLC:            HRS.
INLET AIR TEMP.-DEG.F         82.0    84.0           MIN FLOW RATE: 16 LPM    NOZZLE GUIDE VANE OH:          HRS.
ATMOSPHERIC PRES.-IN.HG      30.01   30.01           MAX TRANS TIME: 2.4 SEC  N1 TURBINE OH :          5112 HRS.
                                                     TEMP.:  250 DEG.F    N2 TURBINE OH :          5112 HRS.
INLET AIR HUMIDITY: .0188 # H2O/# DRY AIR
RELATIVE HUMIDITY :  77%
                                                    PROBE USED : SCOTT 7 HOLE


EXHAUST EMISSION CONCENTRATION DATA AS SAMPLED :

  TEST    THRUST  PWR     N1     N2   FUEL     AIR CALC EXH    EXH    EPR    CO  CO2    THC    NO   NO2  C-NO   ALD
  MODE                   RPM    RPM   FLOW    FLOW  F/A TEMP  PRESS         DRY  DRY    WET   DRY   WET   DRY   WET
            #                         #/HR    #/HR     DEG.F  IN.HG         PPM   %    PPMC   PPM   PPM   PPM   PPM

IDLE        500                6900    710  117485 .006  510                 365  1.21   70.0   0.0   2.0          3.4
75% POWER  5920   75 %        11160   4470  368009 .012  915   31.9           59  2.53    2.0  40.0   3.0          0.1
NORMAL            92 %                              .014                      33  2.86    0.5  53.0   3.0          0.1
MILITARY   8420  100 %        11892   6670  444399 .015 1148   46.7           32  3.14    0.3  78.0   2.0          0.4

EXHAUST EMISSION MASS DATA :

  TEST     --------------- #/# FUEL ---------------        ----------------- #/ MIN -----------------
  MODE
             CO      CO2     THC       NOX      ALD          CO        CO2       THC        NOX      ALD
                                      (NO2)    (HCHO)                                      (NO2)    (HCHO)

IDLE      0.05893   3.07  0.00574    .00268  0.00061      0.69730   36.32   0.06789    .03175  0.00726
75% POWER 0.00471   3.17  0.00008    .00565  0.00001      0.35094  236.35   0.00610    .42109  0.00067
NORMAL    0.00232   3.18  0.00002    .00652  0.00001
MILITARY  0.00205   3.18  0.00001    .00846  0.00003      0.22778  353.16   0.00111    .94050  0.00325
```

APPENDIX IV

MATHEMATICAL METHODS

OUTLIER TEST

There are a number of criteria for testing outliers. In all of these the doubtful observation is included in the calculation of the numerical value of the sample criterion (or statistic), which is then compared with a critical value based on the theory of random sampling to determine whether the doubtful observation is to be retained or rejected. The critical value is that value of the sample criteria which would be exceeded by chance with some specified (small) probability on the assumption that all the observations did indeed constitute a random sample from a common system of causes, a single parent population, distribution or universe. The specified small probability is called the "significance level" or "percentage point" and can be thought of as the risk of erroneously rejecting a good observation. Hence, if there exists a real shift or change in the value of an observation that arises from non-random causes (human error, loss of calibration of instrument, change of measuring instrument, etc.), then the observed value of the sample criterion used would exceed the "critical value" based on random sampling theory. The hypothesis tested in every case is that all observations in the sample come from the same normal population. In the method considered here, we are testing for outliers occurring on both the high side and low side -- i.e. outliers can occur on both sides simultaneously. The statistic used is:

$$(1)\quad T_n = \frac{(\chi_n - \bar{\chi})}{S}$$

$$(2)\quad T_1 = \frac{(\bar{\chi} - \chi_1)}{S}$$

χ_n = high side observation

χ_1 = low side observation

$\bar{\chi}$ = arithmetic mean

S = sample standard deviation

The larger of the above two statistics is used. The 2.5% point of the standardized critical tables is used for a 5.0% significance level.